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Permanent International Association

OF

NAVIGATION CONGRESSES

WORKS CONNECTED WITH OCEAN

AND

INLAND NAVIGATION

BELGIUM

AND

HOLLAND

Notes on the works approved or completed in 1920

Executive Comittee-Office of the Secretary General
38, rue de Louvain, 38
BRUSSELS

UNIVERSITY OF CALIFORNIA
SANTA BARBARA

BELGIUM

I. INLAND NAVIGATION

A. FREE RUNNING AND CANALIZED RIVERS

THE RIVER PORTION OF THE SCHELDT

Extension works on the intermediate reach at Ghent (3rd Section) including: the demolition of the Pêcherie lock, the demolition of the Pêcherie swing-bridge and its replacement by a drawbridge, the improvement of the Pêcherie canal on the right side of the lock to be demolished.

These works, authorised in 1913, form the complement of those executed from 1907 to 1910, in the passage of Ghent by water, in view of making the communications easier between the Upper Scheldt and the port of Ghent, by doing away with two locks. After their completion the Pêcherie Canal will have a depth of 3 m. (9.84 ft.) and an average width of 35 m. (38.2 yds.).

The drawbridge will have a single span of 18 m. (59 ft.) width with a minimum headroom of 6.50 m. (21.3 ft.).

The whole of the extension works of the reach, excepting the drawbridge, was adjudicated in July, 1914, at the price of 353,600 francs, these works were stopped at the beginning of August, 1914, and have not as yet been resumed.

The construction of the drawbridge was the object of a detailed contract and was valued at about 200,000 francs.

The expenses are borne by the State.

* * *

Straightening, widening and deepening of the Scheldt between the Berchem and Audenarde Locks.

Works decided upon in 1913.

The sections will be improved and rectified, the bottom made regular according to a uniform slope and a breadth of 12 m. 50 (34.5 ft.) in view of securing the flow of the flood waters without provoking overflow as also to facilitate and quicken up navigation.

The total cost has been estimated at 1,500,000 francs, purchase of lands included (1914 prices).

This will be borne by the State.

Straightening of the Scheldt in the province of Hainaut, below Kain island.

Works decided in 1919.

Their object is:

1° To suppress two sharp bends of the river;

2° To obtain a line fitting exactly with the new Kain lock and thus to facilitate navigation.

The section to be realized in the straight parts is that formerly approved of in the improvement of the reach programme, that is to say, 12 m. (39.3 ft.) width at bottom with banks at 6/4. The works are estimated at 900,000 francs.

The expense is borne by the State.

(From information supplied, in May, 1920, by Mr. R. Derycke, *Ingénieur en chef Directeur des Ponts et Chaussées, chargé de la 1re Direction du Service spécial du Bassin fluvial de l'Escaut, rue Basse des Champs, 22, Ghent.)*

* * *

Building of five new weirs with locks on the Upper Scheldt, between Tournai and Ghent, situated respectively at Kain, Espierres, Berchem, Audenarde and Asper, to replace the six former ones.

The new works are established close to the old ones except as regards the weir at Asper, situated between the former works of Syngem and Semmersaeke. The three reaches at Ghent, Semmersaeke and Syngen being originally 15, 8 and 8 kms. (9 3/8, 5 and 5 miles) long, are thus replaced by one reach of 20 kms. (12 1/2 miles) and another of 10 kms. (6 1/4 miles). The heights of the weirs vary between 1 m. 45 (4.75 ft.) and 2 m. 76 (9.05 ft.).

These works were seriously damaged or destroyed in October, 1918, on the occasion of the German retreat along the right bank.

The new works, in view of 600 ton boats, have the following dimensions :

Locks : Available length, 125 m. (136.7 yds.).
Width, 14 m. (15.3 yds.).

Intermediate gates permitting the creation of a lock chamber of 41 m. (44.8 yds.) available length.

Sill at a depth of 2 m. 75 (8.82 ft.) minimum below the down stream floating line.

Metallic gates.

Longitudinal aqueducts supplied with Tolkmitt sluices and transversal branches conceived in such wise that the water does not flap the breast of the boat drawing 2 m. 30 (7.54 ft.).

All appliances are controlled electrically, there are also some auxiliary hand appliances.

The type of barge provided for is the 600 ton « Kast », 50 m.× 6.60 (164 ft.×21.64 ft.), drawing 2 m. 30 (7.34 ft.).

Weirs. Only one opening, 18 m. (19.7 yds.).

Closing by Stoney gates with an arrangement for surface overflow of blocks of ice.

Electrical control.

These works can be estimated at, as far as it is possible to do so under present circumstances, 7 or 8 million francs per work. The expenses will be entirely borne by the State.

The parties interested do not financially participate in the enterprise.

The future returns from navigation tolls cannot be estimated, the possible increase of the traffic is about six times the former maximum traffic.

The works are executed by the « Administration des Ponts et Chaussées », with the collaboration of contractors, in the form provided by the contract entitled « The American contract ».

These works were begun before even any rough draft had been made : the studies were gone on with, the plans drawn up, the means of execution collected and contracts secured, up to the present moment, as the work advanced.

At the end of April, 1920, the excavations for two of the works were finished, also the foundation timber work and the concrete

work were commenced (Berchem and Audenarde); the excavations for the three other works are in full swing. The works were begun towards May-June, 1919; after a long period of enforced idleness in that district, which was occupied by the enemy during the war, 2,500 workmen have been engaged since that date.

Bibliography: : *Annales des Travaux publics de Belgique:* 6e fascicule, tome XX (Dec., 1919).

(From information supplied, in April, 1920, by Mr. L. Schoentjes, *Ingénieur principal des Ponts et Chaussées, rue Entre-Ponts, 18, Audenarde.)*

THE LYS

Works for the improvement of the river between the derivation canal called « the Schipdonck canal » and the Astene lock were finally decided on in 1920.

They will comprise the straightening, widening and deepening of the watercourse. Their object is to secure the outflow of flood waters and facilitate navigation in the channel of the Deynze bridge of which the outlet will be enlarged as also the approaches.

The width of the bottom will be 20 m. (21.9 yds.), the slopes will be inclined at 8/4; the depth will be 3 m. 20 (10.5 ft.), and the minimum radius of the curves will attain 120 m. (131 yds.).

The works will cost about 1,500,000 francs and will be exclusively at the cost of the State.

* * *

In 1916 the works for *straightening, widening and deepening of the river* between the Snep bridge and the Municipal Shooting range at Ghent were finished.

These works form part of the program of improvement decided on in view of freeing the upper valley of the Lys from disastrous floods; they concern navigation but little so long as all the proposed rectifications will not have been carried out. They have been executed in such a way as to be able to ultimately realize a width of 16 m. 50 (18 yds.) at the bottom.

The cost, borne by the State, amounted to 234,190 francs.

(From information supplied, in April, 1920, by Mr. De Cavel, *Ingénieur en chef Directeur des Ponts et Chaussées, Ghent.)*

* * *

Some works were also undertaken on the Upper Lys in the year 1919. They comprise:

1° *The suppression of two defectuous curves* between Menin and Courtrai, in view of the improvement of navigation and the flow of the water;

2° *The construction at Menin, for the same purpose, of a diversion of the river* to replace its sinuous course in crossing that locality, as also *the building of a new weir with locks and a fixed bridge,* to replace a swing bridge which gives passage to a light railway line.

The new lock will have the same dimensions as the locks existing on the river Lys, that is to say:

Available length	42 m. 30 (47 yds.)
Width	5 m. 40 (5.9 yds)

and the bridge will be of one single span without any support on the bed of the river.

The works specified in numbers 1 and 2 above, have been valued respectively at 1,000,000 and 4,500,000 francs. The cost is borne by the State.

On the other hand, plans are being proceeded with in view of the *construction of a canal from the Scheldt to Mouscron,* in order to connect this last mentioned locality, which forms an important industrial centre, to the network of navigable waterways of the country. This canal will be accessible to boats of 300 tons.

(From information supplied, in April 1920, by Mr. De Brabandere, *Ingénieur en chef Directeur des Ponts et Chaussées, rue du Faubourg de Tournai, 15, at Courtrai.)*

THE MEUSE

The building of large type locks to be placed against those already existing, on the Meuse near Liége, at Ben-Ahin, Awirs and Jemeppe.

The existing locks have the following available dimensions: 61 m. (66.6 yds.) × 9 m. (9.8 yds.).

Those in course of construction will be 100 m. (109 yds.) × 12 m. (13.1 yds.).

The first only allow the passage through the locks of a boat 5 m. (16.4 ft.) wide and its tug, whilst the new works will allow the passage through the locks of a complete train of boats.

The traffic will no longer be hampered at the passage of the locks, the result will be an increase of traffic and economy in the cost of transport.

The works will cost about 4,000,000 francs per lock.

The costs will be borne by the State.

(From information supplied, in August 1920, by Mr. J. E. Descans, *Ingénieur en chef Directeur des Ponts et Chaussées, Brussels.)*

Building of a new lock to be placed against the existing lock, on the Meuse near Namur, at Andenelle.

The object of this work, decided in 1919, is to continue the old scheme of construction with wide cross-sections of the Meuse locks below Namur, so as to admit the passage of a train of boats of a total tonnage of 1,200 tons, 600 ton boats included.

The new lock will be 100 m. (109 yds.) long and 12 m. (13.1 yds.) wide with a mitre depth of 1 m. 50 (4.9 ft.).

The Andenelle lock will be like the Sclayn lock (1).

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(1) See : *Works connected with Ocean and Inland Navigation*, 1913, p. 12. *Annales des Travaux publics de Belgique.*

The works for the building of the lock and disposition of its approaches have been valued at 4,000,000 francs in round figures.

The cost will be borne by the State.

Normalization, at the same spot, of the Meuse between the Andenne bridge and the « Rieudotte » brook

Between the Andenne bridge and the lock, a single bed will be created of 125 m. (136 yds.) width at the floating line, so as to facilitate navigation and improve the regulating of floods.

The estimate for the works, which are executed at the cost of the State, comes to 1,500,000 francs.

(From information supplied, in May, 1920, by Mr. A. Roba, *Inspecteur général des Ponts et Chaussées, Namur.)*

THE SAMBRE

Construction of a new lock to replace the actual lock at Jambe-de-Bois. This work was decided on in 1919.

The new lock will be 100 m. (109 yds.) long by 12 m. 50 (13.66 yds.) wide with a mitre depth of 2 m. 50 (7.2 ft.); these are the dimensions approved of for the new Sambre locks between Charleroi and the Meuse, they will allow the passing of trains of boats of a maximum tonnage de 1,800 tons, 600 ton boats included.

The cost, which has been estimated at 4,500,000 francs, will be borne by the State.

(From information supplied, in May 1920, by Mr. A. Roba, *Inspecteur général des Ponts et Chaussées, Namur.)*

I. INLAND NAVIGATION

B. CANALS

ANTWERP-RHINE, ANTWERP-CAMPINE-LIEGE AND BRABANT CANALS

At the end of 1919 a special service was created for the study of new canals to be established in the Nort-East part of the country as also to secure the joining up of the Scheldt-Meuse-Rhine.

These canals are :

1) *Antwerp-Meuse-Rhine canal ;*

2) *Campine Colliery canal* following the Beeringen-Genck-Mechelen-sur-Meuse direction and the Quaedmechelen-Herenthals canal section ;

3) *Liége-Lixhe-Genck canal ;*

4) *Brabant canals* comprising, in prime order, a waterway from Vilvorde to Beeringen and, eventually, a branch towards Louvain and another towards Tirlemont.

1) *Antwerp-Meuse-Rhine canal :*

The Scheldt-Rhine junction is in the order of the day since a good many years. Its object is to increase the hinterland of the port of Antwerp by creating a transit canal which would permit of the immediate connection of that port with the Rhine and the German penetration canals as also with the industrial basin of the Ruhr.

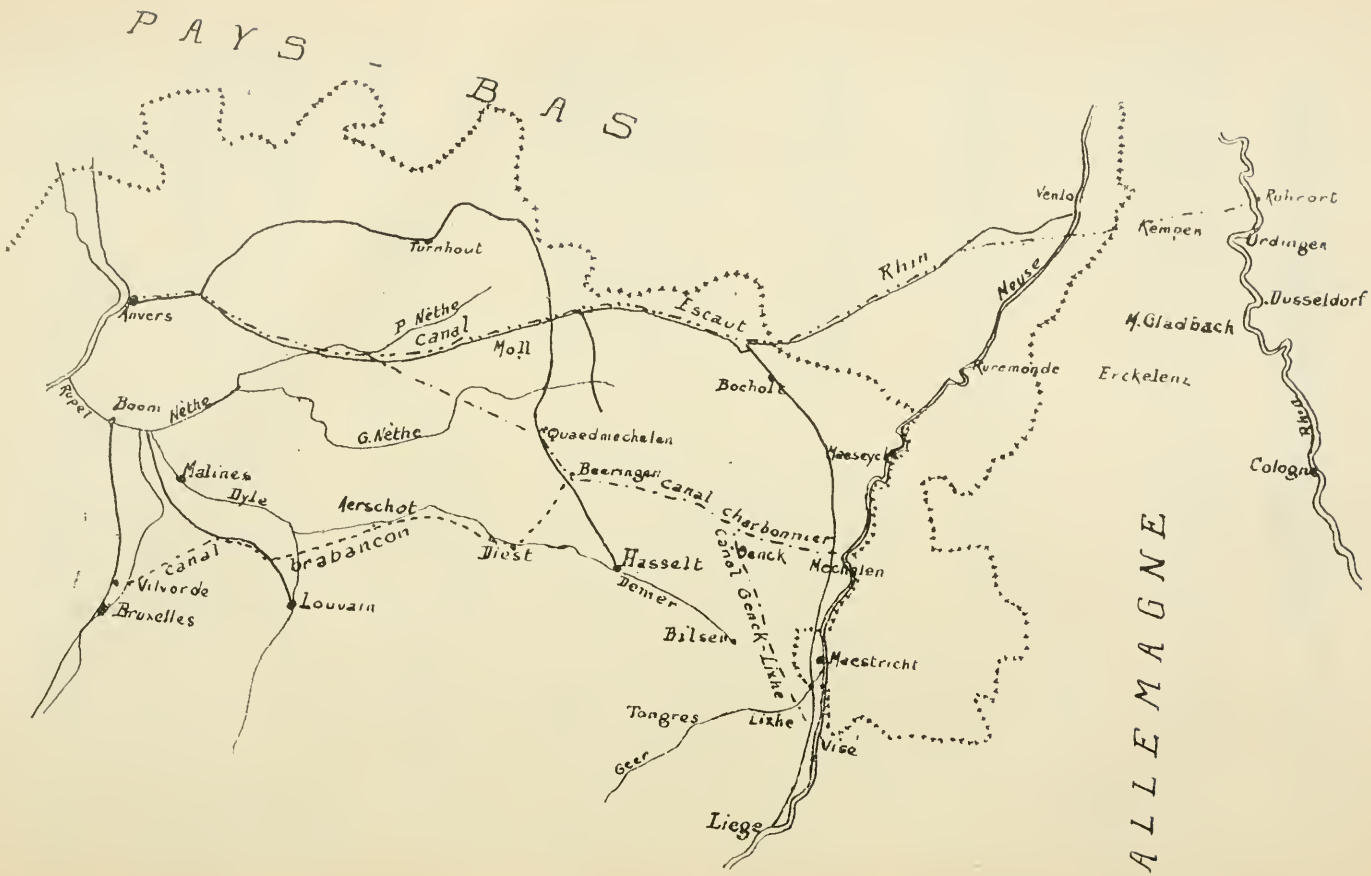
A fairly large number of plans have been tendered by various authors, for the navigable waterway.

Amongst these plans we will retain in particular :

a) The *Hentrich plan* of which the lay-out starts from Antwerp to join the Rhine at Uerdingen, crossing the Meuse on a canal bridge at Belfeld ;

b) *The Valentin plan* which follows the Antwerp-Herenthals-Hasselt lay-out, crosses the Meuse at its level at 2 kms. 500 (1.56 mile) below Maestricht and follows a direction towards the Rhine, where the mouth of this canal is situated opposite Dusseldorf, passing by München-Gladbach ;

c) *Schneiders plan.* Has its source at the Rhine not far from Bonn, crosses Germany to pass the Meuse at Elsloo, follows the direction, towards Genck-Beeringen, through the valley of the


PAYS - BAS
ALLEMAGNE
Turnhout
Anvers
P. Nèthe
Canal
Moll
Escaut
Rhin
Meuse
Venlo
Kempen
Ruhrort
Crefeld
Düsseldorf
M. Gladbach
Roermonde
Erckelenz
Bocholt
Repel
Boom
Nèthe
G. Nèthe
Quaedmechelen
Malines
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Aerschot
Beeringen
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Charbonnier
Canal Genck-Lixhe
Maeseyck
Cologne
Rhin
Vilvorde
canal
brabançon
Diest
Hasselt
Genck
Maestricht
Louvain
Bruxelles
Demer
Bilsen
Tongres
Lixhe
Visé
Geer
Liege

canalised Démer to join the Brussels maritime canal, north of Vilvorde.

The authors of these plans have caused numerous publications to appear in which they defended their opinions. These plans were examined and discussed in a memorandum presented by Messrs. Grenier and Marote, Directeurs Généraux des Ponts et Chaussées, at the Strasburg Congress in 1920.

The line which will be approved of, has not yet been definitely decided on. At the present moment one single point seems settled, that is the Rhine end. Indeed the treaty of Versailles stipulated that Germany should permit the construction of an Antwerp-Rhine Canal beginning at this last named River at the latitude of Duisburg-Ruhrort;

b) *Colliery Canal of the Campine district.*

The installation of the new colliery enterprises of the Campine district are actively pushed on. Certain mines already produce coal at the present moment.

We must think how it will be possible, in the near future, to dispose of the thousands of tons which will be daily extracted and to bring into the Campine district the minerals which will be required by businessmen, who will not be long in settling down close to the centres of coal-production. Therefore it will be necessary to make a local traffic canal connected with Antwerp on the one hand, by a new direct waterway: Antwerp-Herenthals-Quaedmechelen-Beeringen and with Brussels, on the other hand, by the Brabant canal Vilvorde-Beeringen.

This canal was the object of a survey during the war which was undertaken by the Campine district Colliery Association and reproduced in a general report presented by that Association.

Liége-Lixhe-Genck Canal;

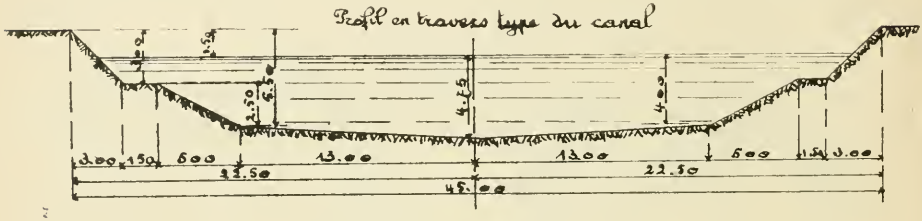
This canal section will connect the centre of the Campine district colliery canal to the canalised Meuse below Visé. In this way, Liége will be placed in direct communication with Antwerp by the centre of the industrial basin of Limburg.

d) *Brabant canals;*

As we have said in § b) the chief artery of the Brabant canals will directly connect the mining centres of the Campine to the port of Brussels.

The lay-out of these new waterways was likewise studied during the war. A detailed report with plans of the future line was published by the Commission entrusted with that work.

All the waterways outlined in the above account, are provided for the traffic of large type Rhine boats of 2,000 tons In view of permitting the traffic of sea barges of 1,800 tons and of cargo boats of 1,000 tons and at the same time inland boats of 2,000 tons, the channel at the bottom of the normal transversal section will be 26 m. (28.4 yds.) wide with 4 m. (13.12 ft.) draught at foot of banks and 4 m. 75 (15.6 ft.) on Canal axis. The slopes will be at 8/4.



Cross-section of canal.

Locks. — The locks will be in couples: one lock of 67 m. × 8 m. 60 (73.3 × 9.4 yds.) will be set against a work of a similar kind 135 m. × 14 (147.3 × 15.3 yds.) the two presenting 4 m. 50 (14.75 ft.) depth on mitres.

Bridges. — The bridges will have to be, as far as possible, fixed, their headroom will have to be at the least 7 m. (23 ft.).

An estimate of the works cannot possibly be given in the present circumstances.

The expenses will be most likely, for the waterway to be established in Belgium, borne by the State: all these works are, indeed, of general interest.

As regards the Antwerp-Rhine canal, the treaty of Versailles stipulated that the portion of the canal to be constructed in Germany should be executed at the cost of that nation.

In the section to be established in Dutch territory, it has not as yet been decided concerning the share of the costs to be borne

by Holland. That will, most likely, depend on the clauses of the revisal of the 1839 treaty.

(From information supplied, in November, 1920, by Mr. P. Glaudot, *Ingénieur principal des Ponts et Chaussées, entrusted with the Direction of the Antwerp-Rhine, Antwerp-Campine-Liége and Brabant canals, rue de l'Aqueduc, 144, Brussels.)*

THE CHARLEROI-BRUSSELS CANAL

The act of the 4th of August 1879, authorized the widening of this canal throughout its entire length in order to permit the navigation of 300 ton barges with a draught of 2 m. 10 (6.88 ft.).

This programme provides for a channel 10 m. 50 (34.4 ft.) wide at bottom with an inclined slope 1 4 and a depth of 2 m. 40 (7.8 ft.). The locks are of an available length of 40 m. 80 (44.5 yds.) and 5 m. 20 (5.7 yds.) in width.

The fixed bridges have generally an opening of 18 m. (19.7 yds.) presenting a navigable waterway of 12 m (13.12 yds.) and two towing paths of 3 m. (3.3 yds.) each.

The minimum clearance is 4 m. (13.12 ft.).

At present the works of enlargement of the canal from Charleroi to Brussels, according to the programme of 1879, are finished between Charleroi and Clabecq (1).

The Minister of Public Works decided in November 1919 to *improve that part of the Charleroi-Brussels canal situated below Clabecq* in prevision of the traffic of 600 tons boats and of the outlet of the flood waters of the Senne.

The length of the canal to be altered according to these dispositions is about 22 kilometres (13 3/4 miles).

The projected works between Clabecq and Brussels have for their object:

1° To secure the circulation of 600 tons boats and thus improve the efficiency of the canal.

2° To free from floods the valley of the Senne by evacuating, per canal, the flood waters of the Senne.

The canal must be capable of evacuating six-tenths of the maximum of floods of the Senne, that is 90 m3 (118 cub. yds.) per second.

The characteristics of the normal channel are shown in the adjoining plan.

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(1) See : *Works connected with Ocean and Inland Navigation*, 1913, p. 27.

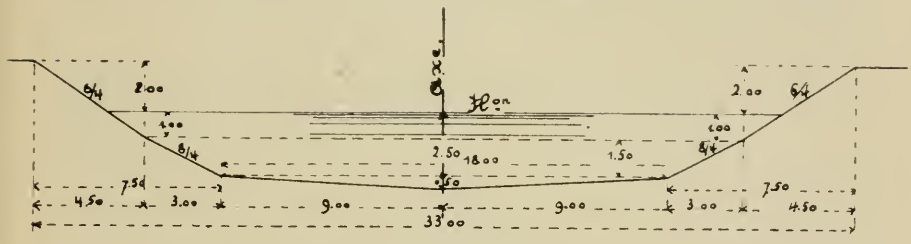
The locks will be of 81 m. 60 (83 yds.) available length and 10 m. 50 (11.5 yds.) width and provided with intermediate gates.

The fixed bridges above Anderlecht will have generally a 26 m. (28.4 yds.) opening presenting a navigable pass of 18 m. (19.6 yds.) and two towing paths of 3 m. (3.3 yds.) each.

Below Anderlecht the navigable channel will be 20 m. (21.8 yds.) wide.

The clearance will be 4 m. 50 (14.76 ft.) maximum for an evacuation of 44 m3 (57.5 cub. yds.) p. s. above Anderlecht, and 60 m3 (78.5 cub. yds.) below Anderlecht.

The works including the purchase of lands, and construction of a 10 m3 collector, valued at 1914 prices, are estimated at 68,000,000 francs.



The Public Works Department will take upon itself the expense of improving the canal in view of 600 tons boat traffic and lowering of water level, the province and municipalities participation being limited to

a) weirs to be placed against locks;

b) widenings at these dams;

c) establishing of water captures for estimating the rising of the Senne.

The question of returns has not been considered.

The plan reckons on a 3,000,000 ton traffic.

(From information supplied, in May, 1920, by Mr. GEERAERT, *Ingénieur principal des Ponts et Chaussées, avenue Albert, 124, Brussels.)*

BRANCH CANAL TOWARDS TURNHOUT

The replacing of 7 actual swing bridges, allowing a navigable passage 5 m. 50 (6 yds.) wide, by new swing bridges of a larger opening.

These works, the execution of which was decided in 1919 are intended to allow of the passage of boats of 6 m. 60 (21.65 ft.) beam.

The new bridges will have a navigable passage of about 11 m. (12 yds.); they will have a single carriage way 2 m. 80 (3.05 yds.) wide with pavements 0 m. 80 (2.62 ft.) wide.

The expenses are entirely borne by the State.

(From information supplied, in May 1920, by Mr. CRENU, *Inspecteur Général des Ponts et Chaussées, Brussels.)*

LIEGE-MAASTRICHT CANAL

Works commenced in 1913 and 1914 and finished during the course of the war :

Construction of timber-fenders (1) for the canal swing-bridge.

On either side of the passage, above and below the swing bridge, fenders have been constructed 13 m. (14.2 yds.) long up stream and 12 m. (13 yds.) long down stream.

Since the erection of these fenders, damage done by boats to the plaforms and abutments of the bridges has become very rare.

The sum total of the estimate was 143,850.28 francs ; that of the tender 125,508 francs.

Transformation and lengthening of lock n° 2 of the canal at Haccourt.

The lock which was at first constructed with a double fall with two lock-chambers 56 m. 50×7 m. (59.2×7.6 yds.) has been transformed into a lock with a single fall of 4 m. 60 (15 ft.) and with a single lock-chamber 83 m. 45×7 m. (91.2×7.6 yds.).

The number of boats locked in a determined period has been increased by 30 p. c.

For the parts of the lateral walls executed in 1916 and 1917, a facing of polished small stone has been chosen to replace a concrete facing with expanded metal.

(From information supplied, in August, 1920, by Mr. J. F. Descans, *Ingénieur en chef Directeur des Ponts et Chaussées, Brussels.)*

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(1) See : *Works connected with Ocean and Inland Navigation*, 1913, p. 44.

MAASTRICHT-BOIS-LE-DUC CANAL

Improvement works on the parts in a straight line with the canal situated between n° 2 bridge at Neerhaeren and the round dock of Neeroeteren, that is to say on a total length of about 15 kilometres (9 3/8 miles).

These works, the execution of which was decided in 1919, have for object the widening of the channel of the canal by encroaching on one of the banks so as to permit the easy crossing of boats of 6 m. 60 (21.65 ft.) beam.

The width of the canal bottom, which is at present 10 m. (10.9 yds.), will be increased to 15 m. (16.3 yds.).

The works are estimated at about 6,000,000 francs.

The expenses are entirely borne by the State.

(From information supplied, in May, 1920, by Mr. Chenu, *Inspecteur général des Ponts et Chaussées, Brussels.)*

II. OCEAN NAVIGATION

A. TIDAL RIVERS

THE MARITIME PORTION OF THE SCHELDT

Strengthening of the quay-walls along the Scheldt, at Antwerp.

These works, the object of which is to prevent the slipping forward of the quay walls, should complete those of the same kind which have already formed the object of four distinct undertakings (1).

A fifth contract (tender approved on the 23rd February 1914) provides for the placing of 13 protecting prisms in front of the Ledeganck quay-wall and the making of 39 barbacans through the wall.

The upper surface of the protecting prisms is situated at 8.80 m. (28.8 ft.) below the average low tide level.

This undertaking of which the cost should have been 1,326,325 francs according to contract, has occasioned an expenditure of frs. 1,437,110.55 and of 87,800 francs bounty on advancement of the works.

A sixth contract (tender approved on 4th April 1919) is in course of execution, for the placing of 10 protecting prisms in front of the Herbouville quay and the making of 30 barbacans through the wall.

The upper surface of these protecting prisms will be at the above mentioned level.

The estimated cost of these works amounts to 1,579,875 francs.

The sum total for the works finished on the 31st December, 1919 attained 1,135,360 francs.

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Dredging of the maritime portion of Scheldt below the mouth of the Rupel. — These works which were begun in 1912 (2)

(1) See : *Works connected with Ocean and Inland Navigation*, 1913, p. 62.
(2) See : *Works connected with Ocean and Inland Navigation*, 1913, p. 67.

have been continued; the total mass dredged from May, 1913 up to the 31st December, 1919 amounts to 1,300,130 m3 (1,700,000 cub. yds.).

Improvement of the Maritime Scheldt between the Jabbeke pass and the Berlaere-Schoonaerde bridge. These works, the threefold object of which is to facilitate evacuation of floods avoid inundations, and improve navigation, are estimated at a sum of 9,395,000 francs. The sum for works finished on 31st December, 1919, amounted to 1,897,960 francs.

(From information supplied, in June, 1920, by Mr. J. Melotte, *Ingénieur en chef Directeur des Ponts et Chaussées, rue de l'Evêque, 58, at Antwerp.)*

II. OCEAN NAVIGATION

B. SHIP CANALS

GHENT-TERNEUZEN CANAL

Reconstruction of the quay-wall situated on the right bank of the canal, between the outer harbour and the Meulestede Brigde at Ghent.

This work decided in 1915 and finished in 1917 was urgently required, the existing wall, threatening ruin.

The new wall consists of solid brick masonry supported on a reinforced concrete platform, established at 30 centimetres (11 3/4 inches) above the normal level of the canal.

The foundations, completely made of reinforced concrete, comprise three rows of piles of 0 m. 30×0 m. 30 (11 3/4×11 3/4 ins.) and 8 m. (8.74 yds.) long, separated one from the other by 1 m. 725 (1.88 yds.); the piles are distant 1 m. 80 (1.96 yds.) one from the other following the length of the wall. The piles of the first and third rows are joined together by longitudinal beams which are in front 0 m. 80×0 m. 30 (2.6×0.9 ft.) and at the back 0 m. 60×0 m. 30 (1.96×0.9 ft.); a transom 1.96×0.9 ft. connects them to the middle pile; this girder work is surmounted by a pugging 27 centimetres (0.88 ft.) thick.

A plank curtain 6 m. 60 (7.21 yds.) long and 0 m. 15 (6 ins.) thick is supported against the back longitudinal part.

The total expenditure for the works of the quay-wall amounted to 443,826 francs. These expenses have been borne by the State.

The construction of the quay wall on a total length of 440 m. 20 (481 yds.) had been adjudicated for the sum of 247,179 francs.

The sums expended for the construction of the wall, on a length of 335 m. (366 yds.), amount to 268,826.45 francs.

The works for the quay walls were begun on the 1st March, 1916 and were stopped on the 15th September, 1917 at about 105 m. (115 yds.) from their upstream extremity.

Bibliography : J. Haché. Construction of a quay wall with reinforced concrete foundation on the right bank of the Terneuzen-Ghent canal between the down stream extremity of the outer harbour and the Meulestede bridge at Ghent. *Annales des Travaux publics de Belgique*. August, 1919, p.p. 219-229; 1 pl.

Building of a large dry dock in the up stream part of the old arm called Langerbrugge.

These works were decreed in 1919.

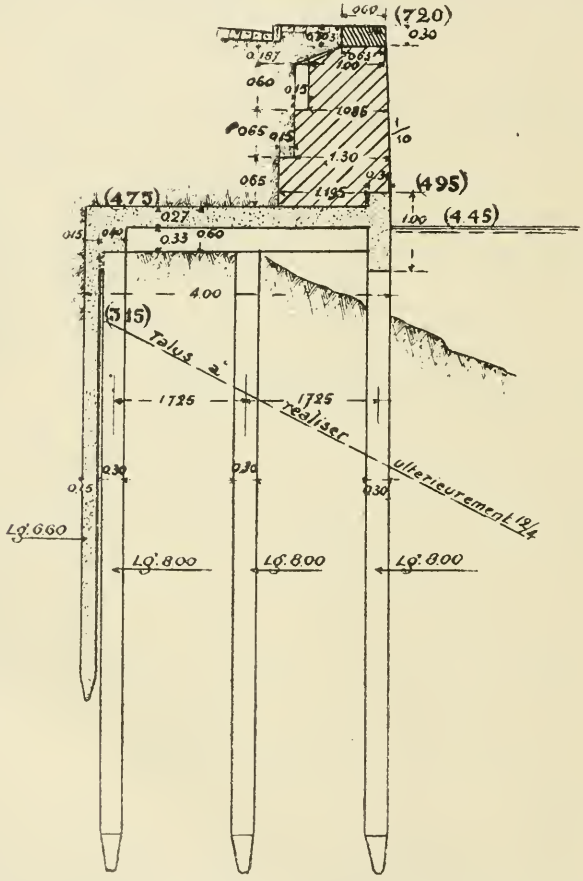
The work is intended to allow of the refitting of the largest steamers resorting to the port of Ghent.

These are the characteristics:

Length on blocks: 210 m. (229 yds.).
Depth at sill. 7 m. 50 (24.5 ft.).
Breadth at the entrance: 26 m. (28.5 yds.).

The method of closing has not yet been settled.

The cost of the works for the dry dock, including the sink



hole, the machinery building, the pumping engines plant, etc., is estimated at 12,250,000 francs.

The costs are borne by the State.

(From information supplied, in May, 1920, by Mr. R. Derycke, *Ingénieur en chef Directeur des Ponts et Chaussées, rue Basse des Champs, 22, Ghent.)*

II. OCEAN NAVIGATION

C. SEA PORTS

SEAPORT OF ANTWERP (1)

Construction of the Southern portion of the canal dock and of the two corresponding wet docks.

These works, commenced in 1909 and finished in 1914, were intended to bring about an extension of the port of Antwerp installations.

Surface of the wet docks and of the canal dock: 67 hectares (165 1/2 acres).

Length of the quay walls: 5,400 m. (5,900 yds.).

Depth: 10 m. 70 to 11 m. 65 (35 to 38 ft.).

Cost of the works: 13,498,308.75 francs.

The expenses are borne by the State.

Bibliography : *Annales des Travaux publics de Belgique.*

a) 3me fascicule, tome XV (June 1910);
b) 5me » » » (October 1910);
c) 6me » » XVI (December 1911).

* * *

Construction at Kruisschans of a sea lock and its entrance channel.

These works approved in 1914, form part of the proposed installations to the North of Antwerp for the extension of the harbour and include (see adjoining plan): the construction of a ship canal and of quay walls connecting the Port of Antwerp with the Scheldt.

Lock: Length: 270 m. (295 yds.).
Width: 35 m. (38.3 yds.).

Available depth: 12 m. 50 (41 ft.) (Average)

Canal dock: Width: 250 m. (269 yds.).
Depth: 10 m. 70 to 12 m. (35 to 38.5 ft.).

Estimate for lock only 17,000,000 francs (1914 prices).

The expenses are borne by the State.

(1) See also « Maritime Scheldt », p. 29.

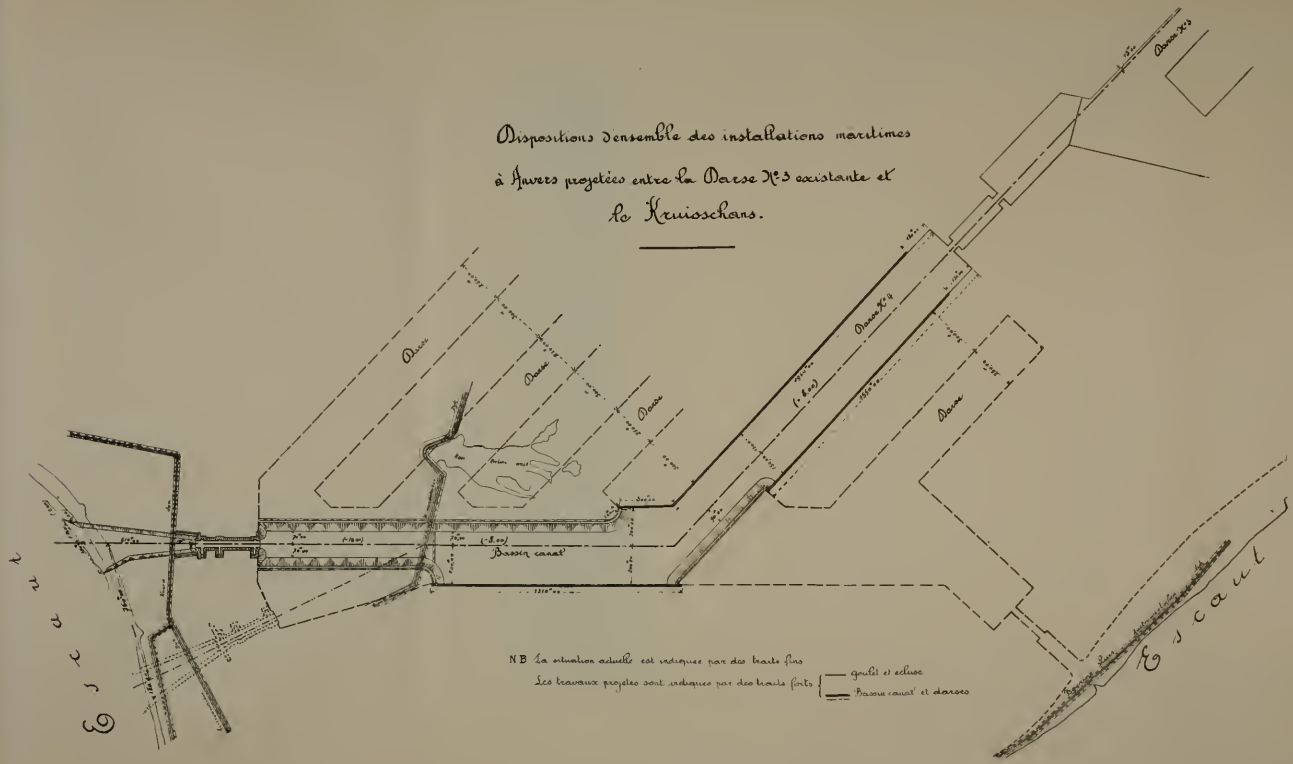
Bibliography : *Annales des Travaux publics de Belgique, 1re fascicule, tome XIX (February 1914).*

(From information supplied, in April, 1920, by Mr. L. Bonnet, *Ingénieur en chef Directeur des Ponts et Chaussées, rue Van Schoonbeke, 76, Antwerp.)*

naritimes

ente et

Dispositions d'ensemble des installations maritimes
à Anvers projetées entre la Darse N.o 3 existante et
le Kruisschans.



NB La situation actuelle est indiquée par des traits fins
Les travaux projetés sont indiqués par des traits forts { — écluse et écluse
— — Bassin canal et darses

PORT OF NIEUPORT

Restoration and reconstruction of the locks and weirs of the port of Nieuport destroyed or seriously damaged during the great world war 1914-1918.

These works comprise:

1° The lock called « *Furnes lock* », and the weir alongside on the Nieuport-Dunkirk canal;

2° The weir at the mouth of the Furnes-Ambacht outlet canal;

3° The lock called « *Ypres lock* » and the weir alongside at the mouth of canalised Yzer;

4° The lock called « *chasse lock* » used as overflow to the old arm of the Yser called Nieuwendamme creek;

4° The lock called « *du Comte* » on the Plasschendaele-Nieuport Canal;

6° The weir at the mouth of the Vladsloo-Ambacht outlet canal.

These six pieces of work, of capital importance as much for navigation as for the outlet of the water, are laid out in fan-shape giving free access to the sea by a channel nearly 3 kilometres (1 7/8 miles) long.

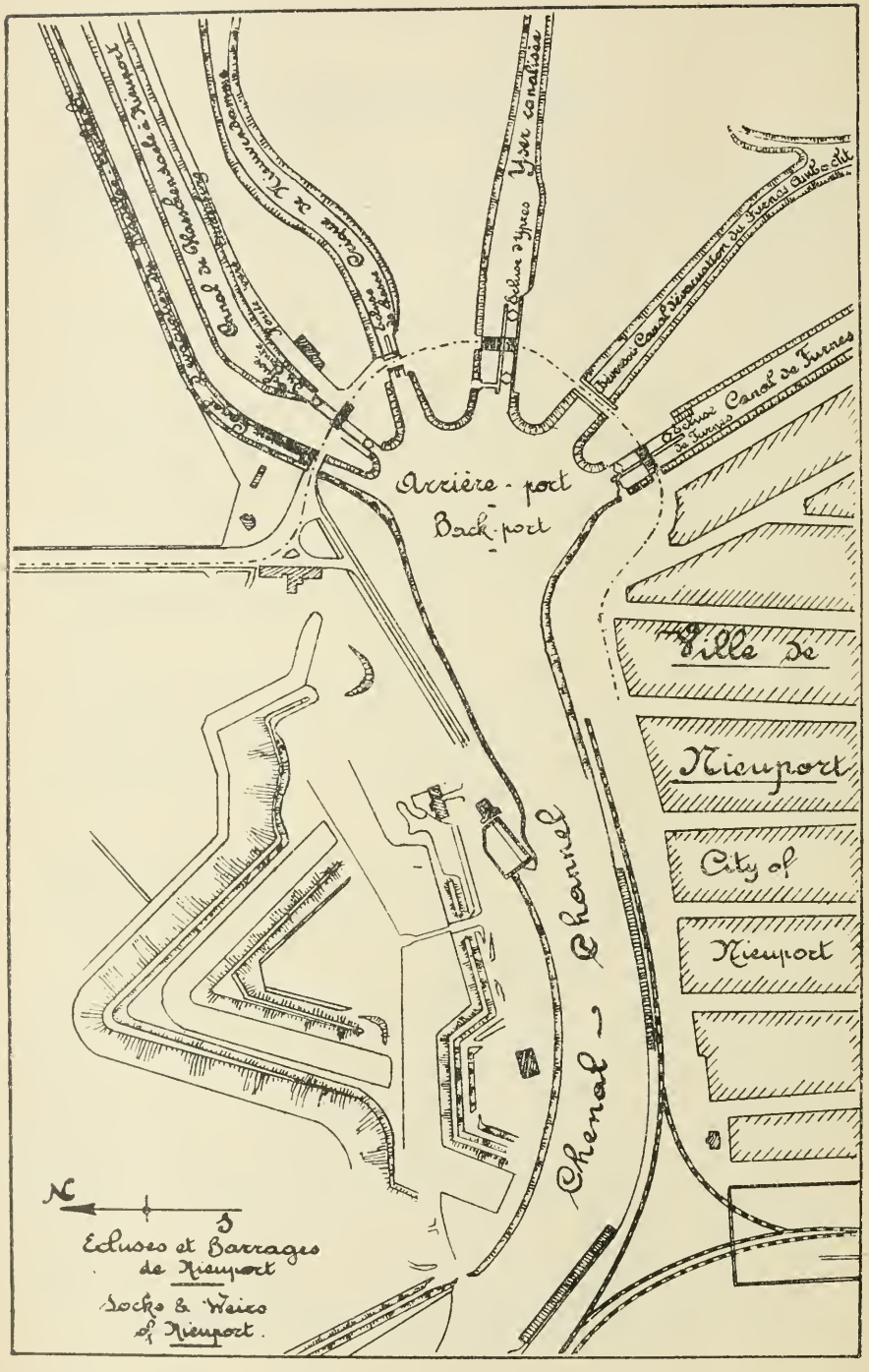
The high road skirting the sea-shore from Knocke via Ostend to Dunkirk, crosses these works on fixed bridges above the sluices and on swing bridges above the navigation locks. All these works are nearly destroyed.

There is hardly a trace to be seen of the six bridges. The Ypres and Furnes locks with their weirs as also the Furnes-Ambacht weir form nothing but a mass of ruins.

The weir of the Vladsloo-Ambacht canal is literally destroyed.

All these works have to be entirely rebuilt, except the floors of locks and foundations which have not as yet been examined in detail but which, it is hoped, will be possible to maintain after a few repairs.

Lastly the « Comte lock » and the « Chasse lock », although seriously damaged, will only require important repairs.


Arrière-port
Back-port
Chenal — Channel
Ville de
Nieuport
City of
Nieuport
Ecluses et Barrages
de Nieuport
Locks & Weirs
of Nieuport.

In annexed table will be found the principal data as to water-lines, depths and dimensions of these works.

NAME OF WORKS	Normal level	Highest flood levels	Width of locks	Total length of locks, including gates	Available length of locks	Number of weir sluices	Width of weir sluices	Level of floors and mitres	Level of coping
			Metres	Metres	Metres		Metres		
Furnes weir lock	2.544	3.794	8.50	73.44	45.05	4	2.10	0.182	6.90
Furnes-Ambacht weir	2.544	3.044	...	...	...	8	2.00	0.329	7.329
Ypres weir lock .	3.25	4.50	8.50	73.14	45.00	5	2.10	0.228	6.90
« Chasse » lock .	2.39	3.70	...	...	...	4	2.05	0.44	6.90
Comte lock . .	4.05	4.15	8.00	75.58	45.40	...	...	0.642	6.90
Vladsloo-Ambacht weir . .	2.39	2.79	...	...	...	3	2.50	0.37	7.30

The programme of the work in hand admits the restoration of the works in their primitive forms and sizes, and considers the possibility of replacing the former swing-bridges by fixed ones.

Considering the extreme variability of the prices of materials and of wages, and of the degree of advancement of the plans and projects which, considering the urgency of the works, are elaborated at the same time as they are carried out, it has only been possible to proceed to a general and approximative estimate of the works. They have been valued at the sum of 22,500,000 francs, entirely borne by the State.

(From information supplied, in May, 1920, by Mr. De Schryver, *Ingénieur principal des Ponts et Chaussées, at Nieuport.)*

PORT OF OSTEND

New fishery installations to be created on the east bank of the port channel.

The object of these works, decided in 1919, is to provide the fishing industry with modern installations in order that it may have all the scope it is capable of.

The fishing port will comprise:

1° A tidal basin 300 m. (328 yds.) in length, by 60 m. (65 yds.) in breadth, for the use of the sailing trawlers;

2° A wet dock 700 m. (765 yds.) long by 80 m. (87 yds.) wide for steam trawlers.

It has been decided to construct a basin to begin with, of a length of 450 m. (488 yds.) from the end wall. This floating dock will communicate with the Ostend Port passage by:

3° A lock with chambers having an opening of 16 m. (17.5 yds.) and 90 m. (98 yds.) available length with two single way road-bridges;

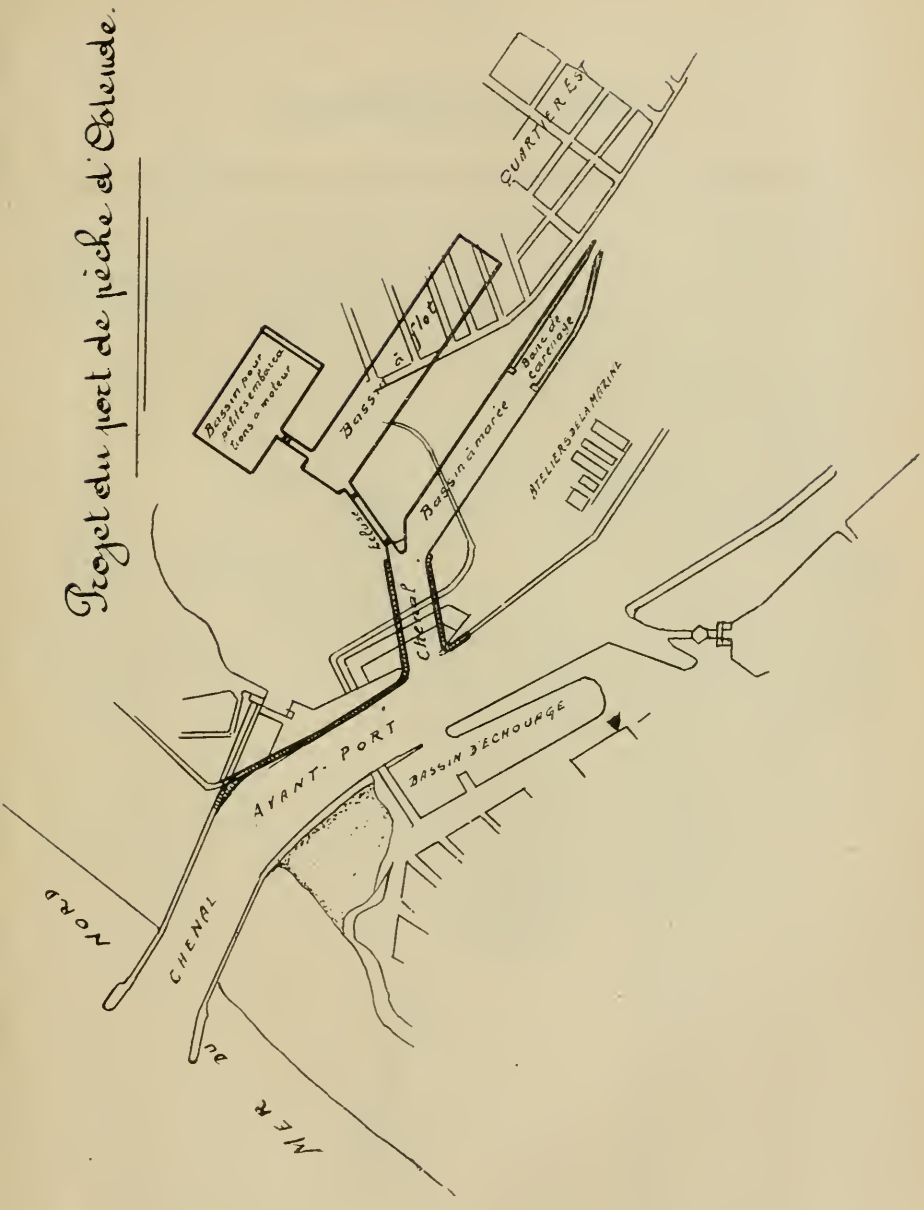
4° Installations for the repairing and refitting of fishing boats;

5° A careening dock 60 m. (65 yds.) wide.

The proposed new installations are marked on the accompanying plan.

The estimated value of the works is 55 million francs; the cost will be borne by the State. The estimate is given according to the detailed measurements of the plan, adopting different prices which are more or less near the exact prices.

(From information supplied, in May, 1920, by Mr. P. J. Van der Schueren, *Ingénieur en chef Directeur des Ponts et Chaussées, avenue Henri-Serruys, 24, at Ostend.)*



Projet du port de pêche d'Ostende = Proposed fishing port at Ostend.— Chenal = channel. — Avant-port = fore port. — Bassin d'échouage = stranding dock. — Bassin à marée = Tidal dock. — Bassin à flot = floating dock. — Bassin pour petites embarcations à moteur = Dock for small motor-boats. — Ateliers de la marine = Naval workshops.

PORT OF ZEEBRUGGE

Tidal basin to be established for the use of fishing boats.

The object of these works, sanctioned in 1911, is to promote the development of Ocean fishing, by placing at the disposal of owners, docks and quays accessible to the biggest steam trawlers at any state of the tide.

Principal dimensions of the dock:

Length: 300 m. (328 yds.);

Breadth: 80 m. (87.4 yds.);

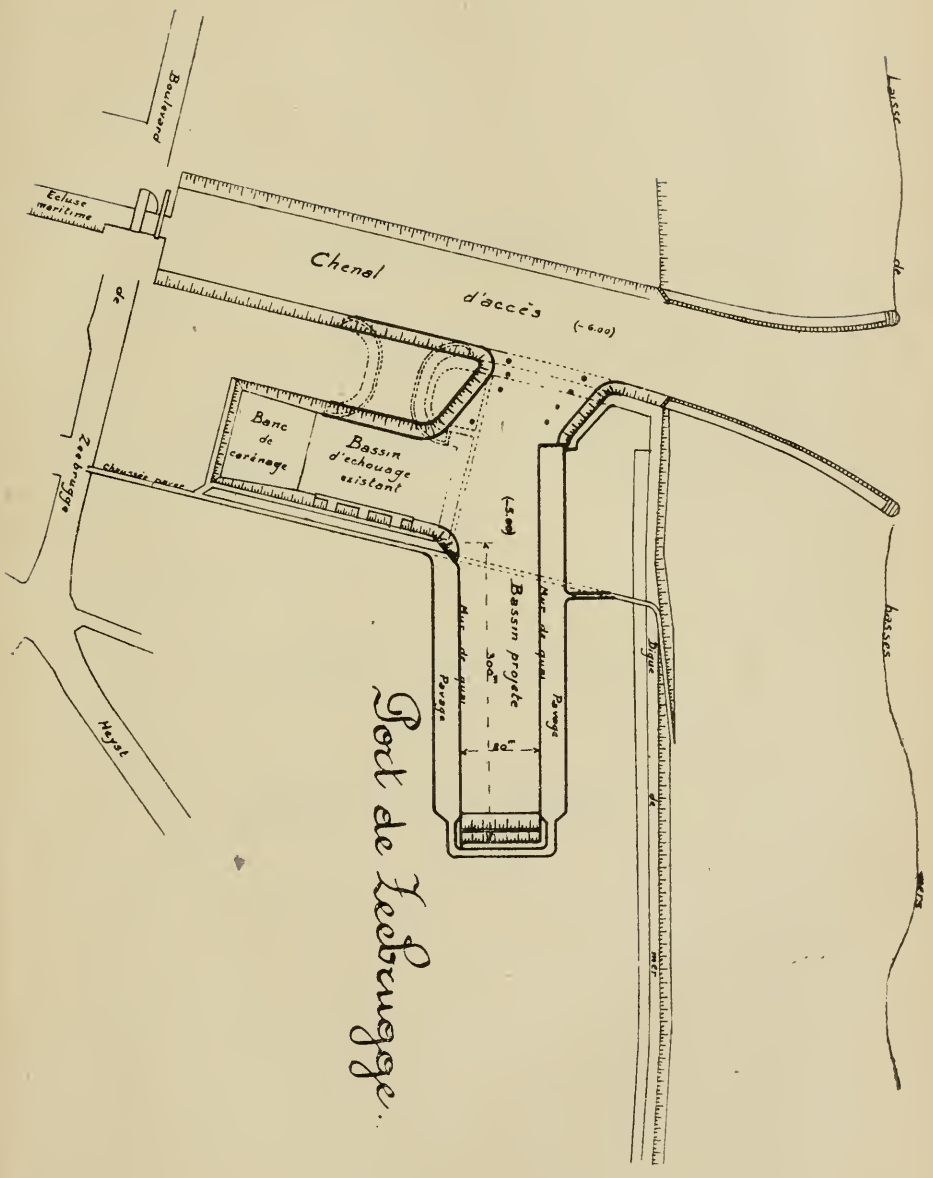
Anchorage: 5 m. (16.4 ft.) at low tide.

The adjoining sketch shows the dispositions of the proposed dock.

The estimate for the works is 7,000,000 francs. The cost will be borne by the State. The estimate is made by applying to the measurements the unit prices of 1914 increased by about 250%.

No dues are levied from the fishing boats.

(From information supplied, in May, 1920, by Mr. P. J. Van der Schueren, *Ingénieur en chef Directeur des Ponts et Chaussées, avenue Henri-Serruys, 24, at Ostend.)*



Chenal d'accès = Entrance channel. — Ecluse maritime = Sea lock.— Banc de carenage = Careening dock. — Bassin d'échouage existant = Existing stranding dock. — Bassin projeté = proposed dock. — Digue de mer = Dike.

HOLLAND

I. INLAND NAVIGATION

A. FREE RUNNING AND CANALIZED RIVERS

THE MEUSE

The law of the 12th of June 1915 decreed the work of *canalizing the Meuse from the Belgo-Dutch frontier near Maasbracht to Grave* and also the construction of two canals to join the canalised river to the navigable waterways existing in Holland, that is to say a canal from Wessem to Zuid-Willemsvaart, near Nederweert and a canal from Mook to the Wahal (the principal tributary of the Rhine) near Nimègue.

In order to make the Meuse navigable for ships carrying 2,000 tons, ships 100 m. (328 ft.) long, 12 m. (39 ft.) wide and drawing from 2 m. 40 to 2 m. 80 (7.87 to 9.18 ft.), the regulation of the river would not be sufficient, considering that in the summer its flow is very deficient and does not generally exceed 60 to 80 m3 (78 to 104 cub. yds.) per second and may even descend as low as 25 m3 (32 cub. yds.) as the observations of September, 1919 proved. To this feeble flow is joined a rather pronounced slope of 0 m. 40 (1.3 ft.) per kilometre (1,093 yds.) in the upper part of the river, and this slope diminishes between Ruremonde and Venlo to 0 m. 06 (2 1/2 ins.) per kilometre.

At the period of high waters in winter, the flow may reach 2,700 m3 (3,500 cub. yds.). The banks are then flooded to an extent of 1 to 5 kilometres (5/8 to 3 1/8 miles). The difference between the highest and the lowest waters, which is about 5 m. 50 (18 ft.) at Maasbracht, rises at Venlo to 10 m. (32.8 ft.).

The canalising implies the setting up of weirs at Linne, at Ruremonde, at Belfeld, at Afferden and at Grave with locks for navigation. The weirs will be of an adjustable type in order to be able to evacuate the high waters of winter.

The weirs and locks of Linne and Ruremonde, the construction of which has started, will be established in the large curve derivations those of Belfeld, Afferden and Grave in the bed of the river itself.

The principal object of the canalisation is to create a navigable waterway for Rhenish boats of 2,000 tons in view of transporting coal from the coal mine districts of South Limburg to the centre of Holland. Works have been proposed to join the canalised

river to the collieries but no decision has yet been taken on this subject.

The canalised river will have a maximum depth of 2 m. (6.5 ft.) which it will be possible to increase to 3 m. (9.8 ft.) by dredging.

To realize this dredging the reaches will have their floating lines at a level which will reach 1 m. 85 to 3 m. 25 (6 to 10 1/2 ft.) above the average levels of the Summer waters.

The reaches will be:

Between Linne and Ruremonde, 13 kilometres (8 1/8 miles) long.

Between Ruremonde and Belfeld 20 kilometres (12 1/2 miles) long.

Between Belfeld and Afferden 45 kilometres (28 miles) long.

Between Afferden and Grave 30 kilometres (18 1/2 miles) long.

The locks will be set up in channels with a floor 40 m. (43 yds.) wide and a depth of 3 m. 30 (10.7 ft.) below the lowest waters.

The dimensions of the locks have been fixed in view of the simultaneous locking of two boats of 2,000 tons and of a tugboat. The available length will be 260 m. (284 yds.) with an intermediate head, the width of the upstream and downstream heads will be 14 m. (15.3 yds.) the depth on mitres 3 m. 30 (10.7 ft.) at the lowest waters.

The lock chamber will be 16 m. (17.5 yds.) broad.

The maximum fall will be 3 m. 65 (12 ft.) for the Linne lock 2 m. 75 (9 ft.) for the Ruremonde one, and 3 m. 25 (7.37 ft.) for the others. The Linne lock is in course of construction (in 1920) as to that of Ruremonde and the Linne weir the banking works have begun.

The initial scheme for the Linne weir includes a navigation channel of 60 m. (65.6 yds.) breadth and three overflow channels of 17 m. (18.5 yds.) breadth.

At Grave the construction of a weir with a bridge above for the passage of a road is under consideration.

The total cost of the canalisation works was estimated at 20 million florins in 1915 One can reckon on an amount three times as high.

The works are carried out by the State which bears the whole of the expenses. The State will not derive any direct returns from navigation.

It is expected that there will be a traffic of 2 million tons of coal for the first years after the completion of the canalisation; this traffic will no doubt increase considerably with the industrial development of Southern Limburg.

(From information supplied, in July, 1920, by Mr. F. L. SCHLINGEMAN, *Engineer of the Rykswaterstaat, at Ruremonde.)*

Bibliography : *De Ingenieur*, n° 17 of 1919. *Annales des Travaux publics de Belgique*, fascicule n° 5 of 1919.

CONSTRUCTION OF THE LOCK AND THE WEIR OF LINNE

Lowering of the level of the water stratum.

The lock and the weir are both built in cuttings in the river. The construction of these art works could therefore be entirely done in the dry. The bottom of the Meuse valley is composed, in this part, of a mingling of gravel and sand, reaching down to a very great depth, and covered with a layer of clay from 2 to 3 m. (6.5 to 9.8 ft.) in thickness. This ground is very resisting and is very permeable to water. The sheet of water is entirely dependent on the levels of the rivers and follows with a slight delay the fluctuations of the latter.

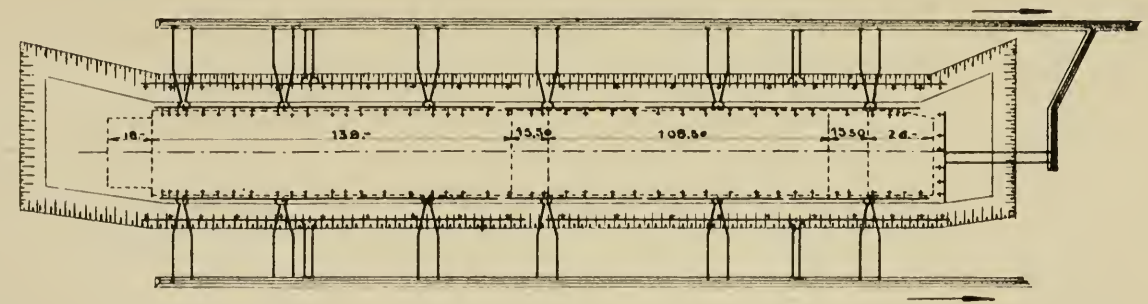
The site of the lock was on ground protected by a dike against the high waters of the Meuse, whilst the site of the weir was in the winter bed of the river.

The lower surface of the foundations of the two works is situated at about 6 m. (19.7 ft.) below the natural summer level of the water stratum. It was then evident that to build the foundations in the dry, considering the nature of the ground, there ought to be very efficacious draining.

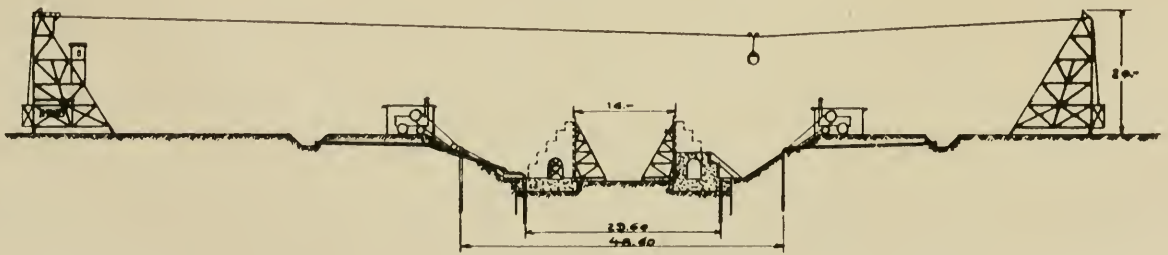
In order to gather a little information concerning the volume of water which would have to be pumped to obtain a sufficient fall of the water level, in 1916 close to the place where the lock was to be set up, a trial installation was constructed which was put to work. This latter consisted of ten tubes, of 12 m. (13 yds.) depth the 5 lower meters of which were arranged as filters. These tubes were united by a collecting tube, on which was placed through the medium of an air tank, two centrifugal pumps with an output of 100 litres (22 gals.) per second, with a charging height of 8 m. 50 (27.88 ft.). Before and whilst the pumping installations were set going, the fluctuations of the level, at the spot under observation and in its neighbourhood, were watched by means of hydrometric tubes. This small trial installation allowed of the lowering of the water level by about 3 m. 50 (11.5 ft.) with an outflow of 180 litres (40 gals.) per second. Considering the results attained, it was decided to

Construction de l'écluse à Binne avec installation pour le rabattement de la nappe aquifère

Plan



Coupe transversale



exhaust the lock and the weir excavations by means of filtring tubes; it could be foreseen that in spite of the great quantities of water one would have to exhaust, quite dry excavations would be obtained without the bottom being entirely unsettled by the running water. Besides the excavations could be thus reduced to a minimum. The estimates based on the trial results led to the supposition that it would be necessary to exhaust in the two excavations, a maximum quantity of 1,000 litres (220 gals.) per second.

The adjoining plan shows in plan and cross section the draining installation established for the Linne lock. This latter was composed of two separate installations, an upper one and a lower one. The pumps for the upper installation, with the principal suction tubes, were placed as low as the water level allowed it. With an outflow of about 500 litres (110 gals.) per second in the course of clearing the excavation the lowering of the water stratum by about 4 m. (13.12 ft.) was accomplished, which corresponded with the level of the upper surface of the floor.

After the excavation had been cleared and dried, the pumps of the second pumping installation were placed at this level, in view of still further lowering the water level by about 2 m. (6.56 ft.). The pipes for this lower installation were placed inside the enclosure of steel pilings 6 m. (6.56 yds.) high which surrounded the whole excavation, so that the resistance opposed by this circumference to the water running through the soil, favoured the drainage.

For the lower draining installation on each long side of the excavation, 40 filtering tubes were placed. These tubes carried zinc or galvanised iron nozzles 8 m. (8.74 yds.) in length and 0 m. 20 (8 ins.) in diameter. The lower part 4 m. (4.37 yds.) in length, formed a filter and was pierced by slits 18 millimetres (6 1/2 ins.) wide, so that water passed through only 1/5 of the nozzle surface. Before placing the filtering tubes, boring pipes of 0 m. 50 (1.64 ft.) diameter had been driven into the ground, this was often very difficult to effect because of the gravelly soil. After having placed the filtering tubes in the centre of the pipes the intermediate space was filled with sifted gravel so as to form an outside filter around the filtering tube. Then the boring pipe was drawn out and the water pumped out of the filtering tube.

In every filtering tube a suction pipe of 125 millimetres (5 ins.) width was hung; these suction pipes came out into a principal suction pipe of 250 millimetres (10 ins.) diameter, conveying the water to the pumps. On each principal suction pipe four or five filtering tubes were branched. The pumps were of centrifugal type, capable of drawing 80 litres (17 1/2 gals.) per second to a height of 12 m. (39 ft.). The pumps were coupled two by two on a common axle, actuated by a portable steam engine or by a 50 HP. electrical motor. The electrical starting offered great advantages considering the facility for mounting and working, but there was one disadvantage, that it was put out of use in case of interruption of the current. That is why, considering the imperious necessity of continuous pumping, only three pumps out of nine were electrically driven, the others were steam driven. As a result of the extreme distribution of power and of the whole pumping plant into units entirely independent of one another there was never a serious interruption in the draining. At the beginning all the chief suction pipes, situated on the same side of the excavation, were united by a continuous pipe of which the different sections could be separated by sluice-valves. That had been done with the intention of being able to use every pump as a reserve, one for another. But the pipes of about 300 m. (328 yds.) length occasioned difficulties, arising from the expansions caused by the temperature. Besides, it was extremely difficult to conduct the air which accumulated in these long pipes towards the pumps, and what is more the many joints caused air leakage. Consequently one rapidly reached the separation of the suction pipes of each pump. Also on account of the great permeability of the soil, the desired reserve was sufficiently obtained.

The portable steam engines which drove the pumps, worked with surface condensation. The air pumps of the condensers served at the same time to create a vacuum in the suction pipes of the pumps. A good deal of inconvenience was experienced, mostly at the beginning of the exhaustion works, because of the presence of air in the pipes, which prevented the pumps from developing their total capacity. Different remedies were tried without result. It had to be decided to increase the number of pumps so as to compensate for the decrease of their capacity.

An enlarging of the pump blades likewise contributed to improve the situation. For the lower draining installations, where the suction height was less, the above mentioned disadvantage was experienced in a lesser degree also.

The above described pumping installation permitted the keeping of the basement excavation entirely dry during the course of the Summer 1920 at the ordinary summer level of the Meuse. The greatest quantity of water pumped reached about 1,200 litres (270 gals.) per second and the greatest lowering of the stratum level about 6 m. 50 (21.2 ft.) between the sides of the plank enclosure.

The variations of the level of the water stratum in the neighbourhood of the work were watched by means of sounding tubes. The lowering of the water level is noticeable to about 1,500 m. (1,640 yds.) from the excavation. During the course of the very dry Summer of 1921, the exhaustion was considerably less than that expected.

The usefulness of the filtering pipes installed inside the enclosure was clearly shown. At the time of the maximum lowering, a difference of 0 m. 80 to 1 m. (2.6 to 3.28 yds.) between the water levels on the two sides of the enclosure, was noticed.

The works on the Linne locks were begun in April, 1919. In the course of the Summer of the same year, excavations were made which included a clearance of 160,000 m3 (208,000 cub. yds.). One expected, during the course of that year, to be able to take down the planking but the steel pilings were note delivered in time.

In 1920 the levels of the Meuse remained such that the drying of the excavation was not possible till May. When the planking had been pulled down in August, the concrete works could be commenced. The lock is entirely built of concrete which is composed of 1 part of cement, 3 parts sand and 6 parts gravel. The concrete of the lock-head aprons, which, in order to be able to resist the under pressure when the locks are emptied, are provided with a strong armature, is alone composed of 1 part of cement, 2 parts of sand and 3 parts of gravel. All of the concrete walls have remained bare. In order to obtain a smooth facing sheet iron cases were used. These cases were movable

and allowed of the construction of sections of walls 11 m. (12 yds.) long directly on the whole height. For handling the concrete two 3 ton cable cranes were installed of which the cables stretched across the width above the excavation. The delivery of these machines was greatly delayed through the then unfavorable circumstances. The concreting could consequently only be partly completed, when the high waters of the Meuse, last December, made the continuation of the works impossible.

In 1921, the lock was terminated, 700 tons of metallic piling had been employed and 38.000 m3 (39,700 cub. yds.) of concrete.

The aqueduct and sluices as well as the electric equipment are in course of construction at the present moment (January, 1922).

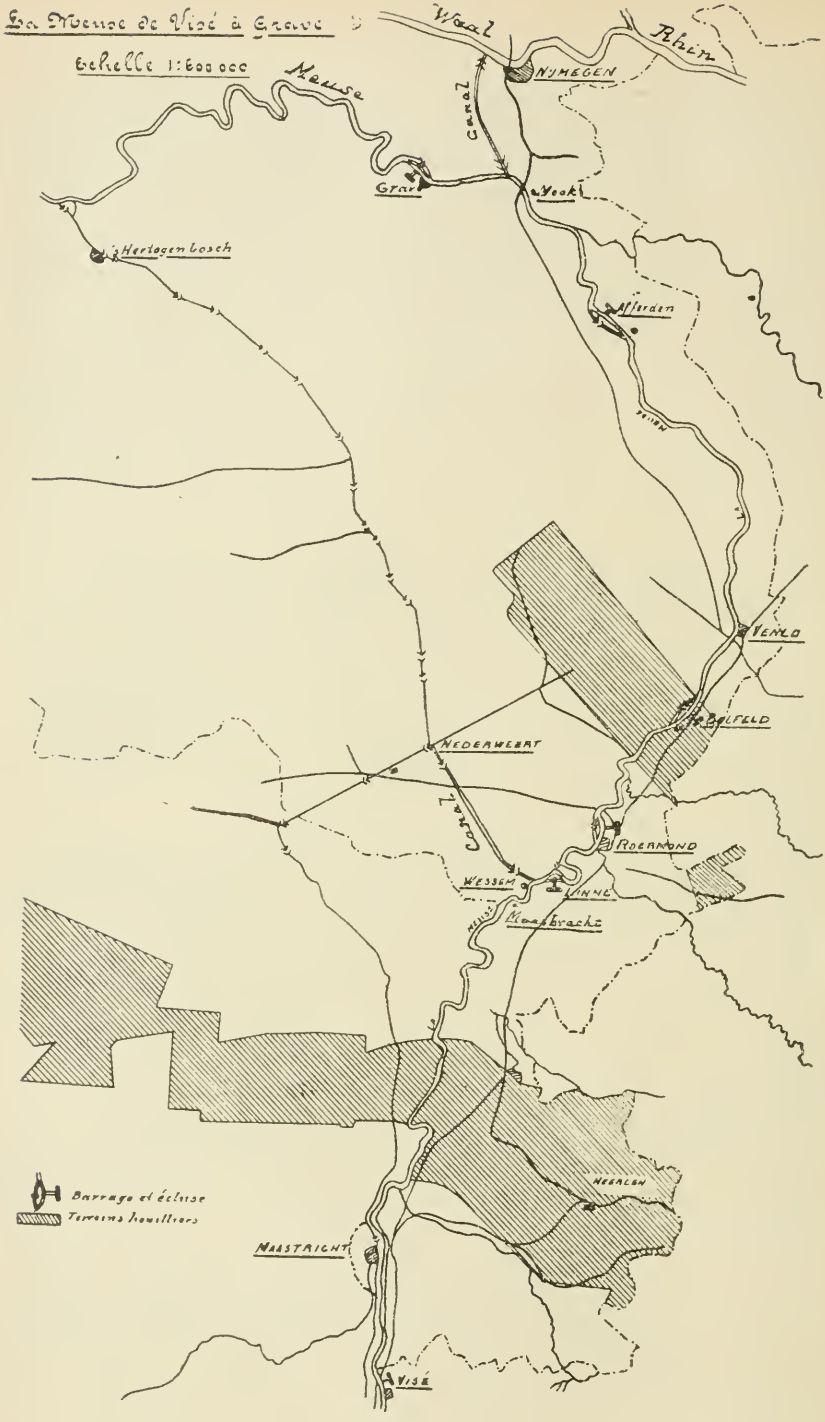
The draining installation for the excavation of the Linne weir is, in principal order, the same as that for the lock, with the only difference that special filtering pipes for the upper draining have not been fixed up, but after having sufficiently lowered the water stratum by means of a few pumps, the consecutive plant was immediately fixed up at the definite level. Eight pumps of 50 horse power each are necessary to obtain the maximum lowering. The draining was also quite successful.

When in 1920 the excavation has been cleared and the greater part of the piling had been pulled down, the bottom of the weir, the abutments and the piles in the river were placed and also a part of the front aprons. The weir will be finished in 1922.

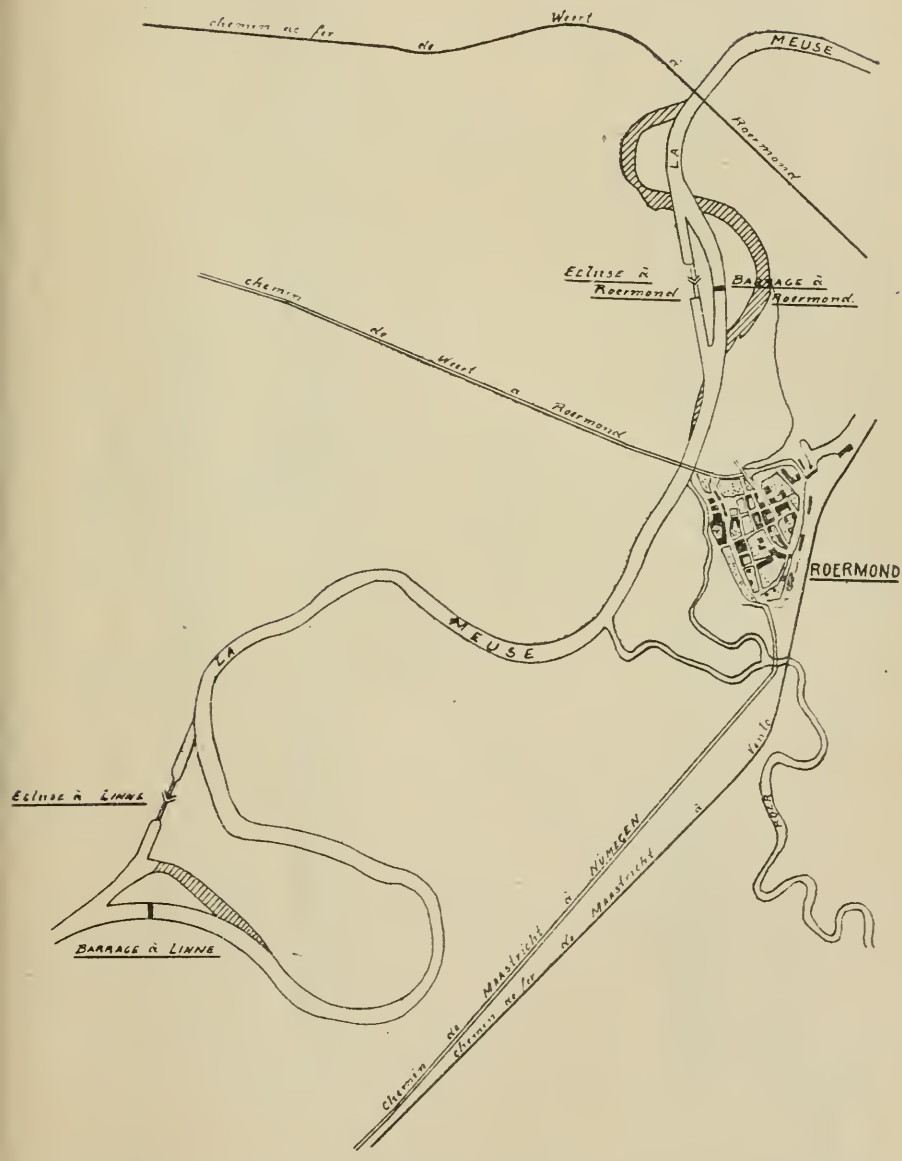
As for the lock the whole of the masonry work is in uncovered concrete, only the corners and the recesses are fitted with iron armatures. The weir will have two fish ladders of the Engineer Denil type.

The finishing of the new reach of the river in which the lock stands, and the access channels to the lock will require still some more time. But it is probable that the works can be put into service in 1923.

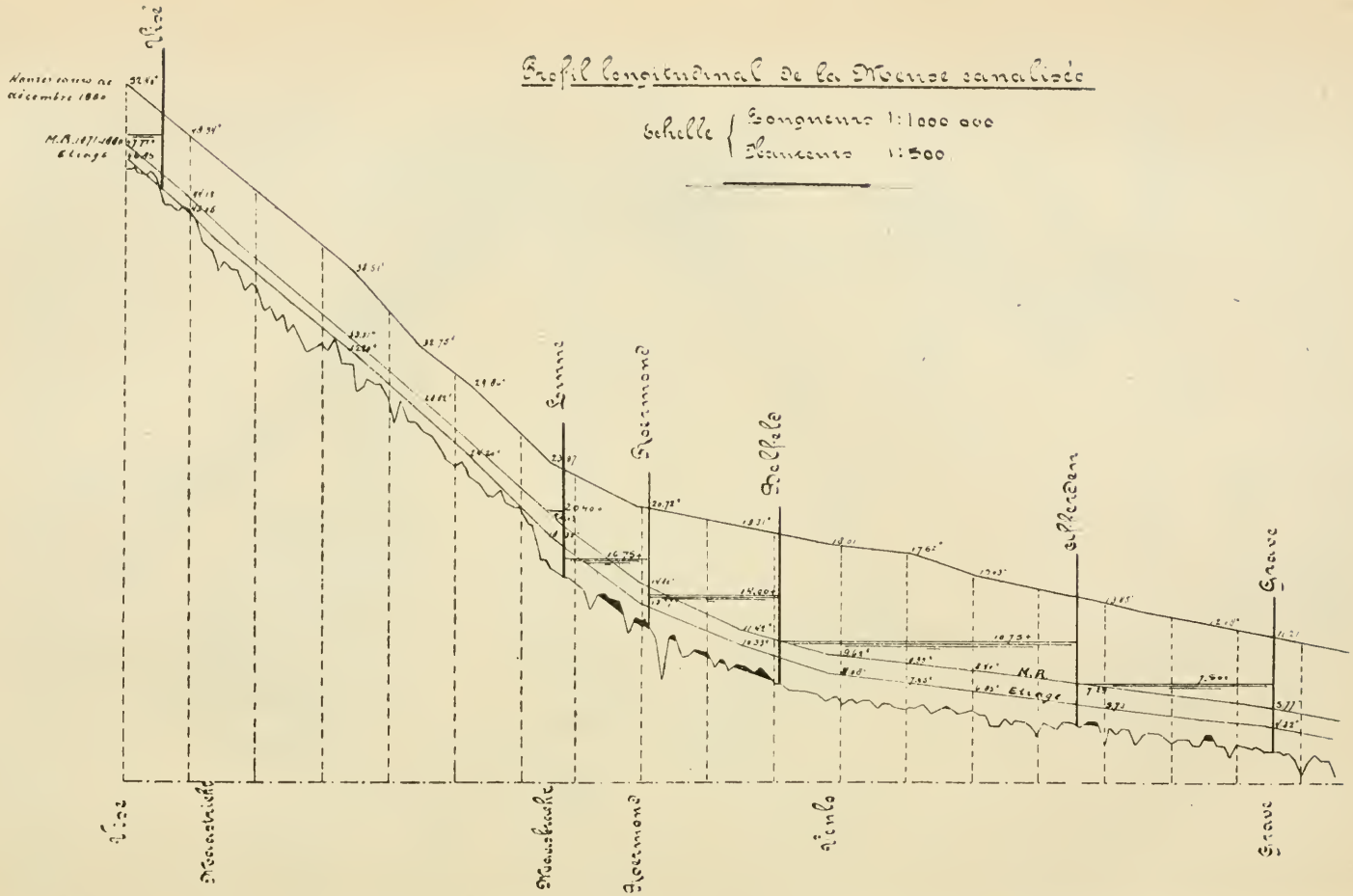
(Supplementary notes supplied in 1922. by Mr. SCHLINGEMAN, *Ingénieur du Rijkswaterstaat, at Ruremonde.)*



Barrage et écluse = Weir and lock. — Terrains houillers = Coal fields.



Situation des barrages et des écluses à Linne et à Roermond = Position of the weirs and locks at Linne and at Roermond. — Chemin de fer = Railway.



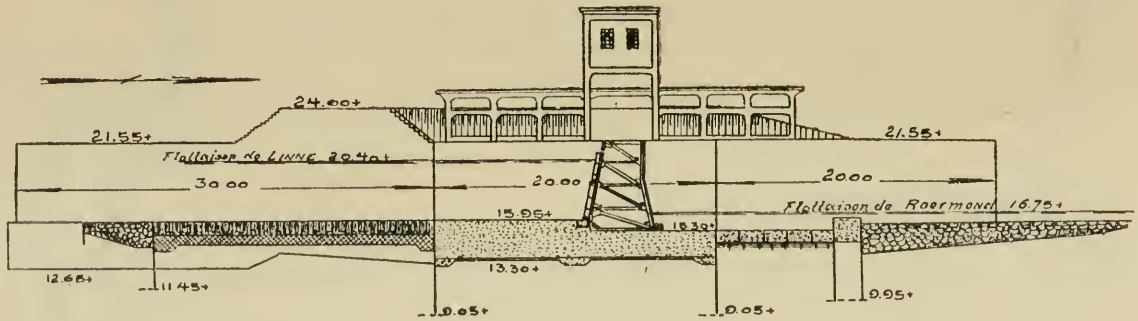
Profil longitudinal de la Meuse canalisée = Longitudinal section of the canalised Meuse.

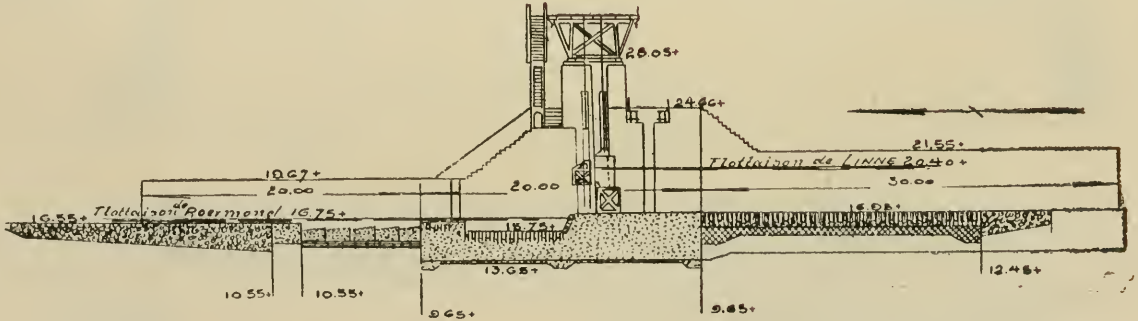
Echelle { Longueurs : 1 : 1,000,000 / Hauteurs : 1 : 500 } = Scale { Lenghts : 1 : 1,000,000 / Heights : 1 : 500 }

Projet de barrage à Linne.

Section par la passe Navigable.

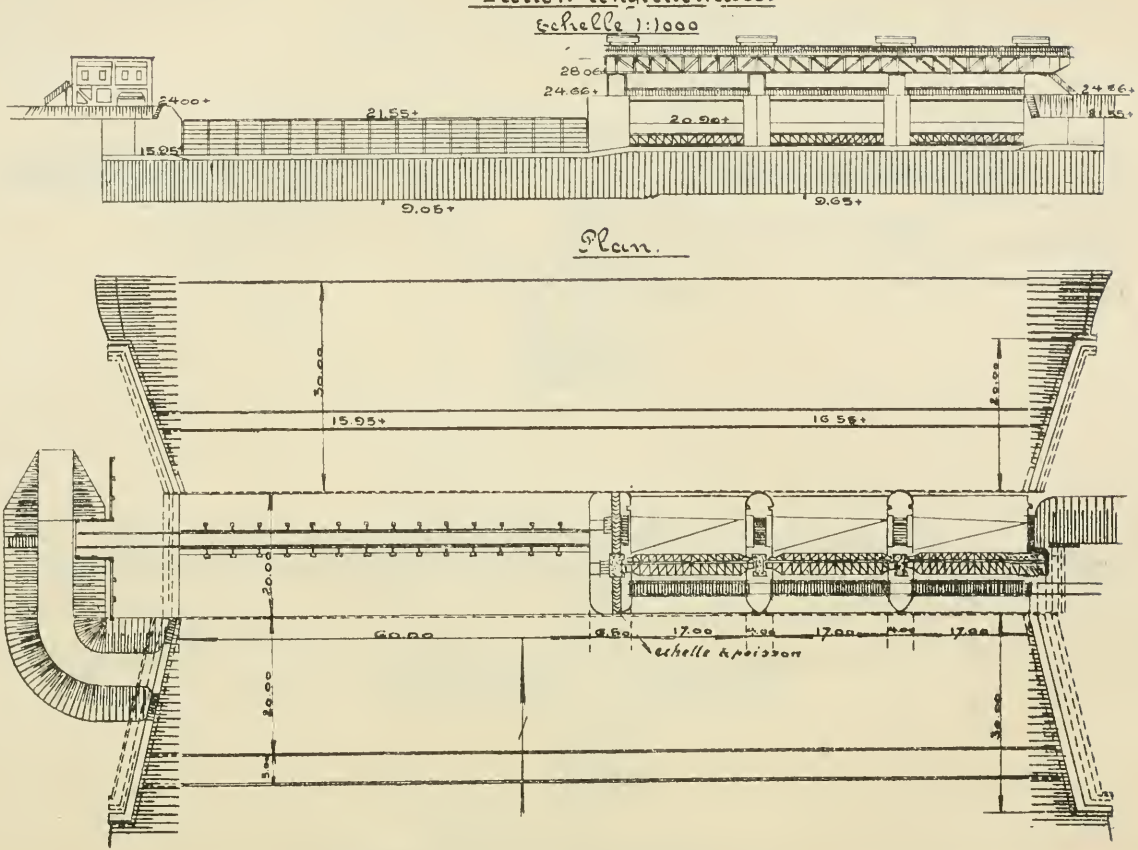
Echelle 1:500





Section par les passe-déversoirs.

Projet de barrage à Linne = Scheme for weir at Linne. — Section par la passe navigable = Section through navigable channel. — Echelle : 1 : 500 = Scale : 1 : 500. — Section par les passe-déversoirs. — Section through the diverting channel.

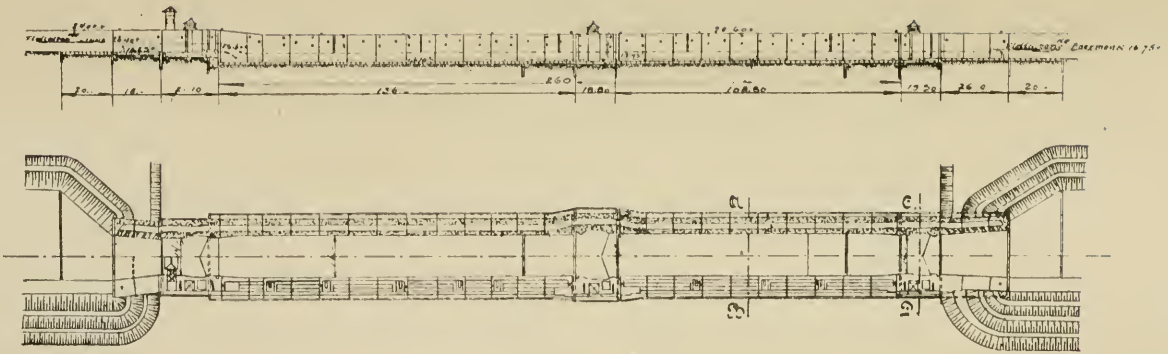


Echelle à poisson = Fish ladder.

Projet de l'écluse à Linne.

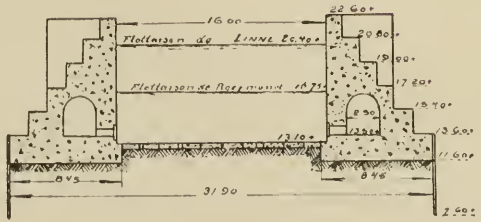
Plan

Echelle 1:2500

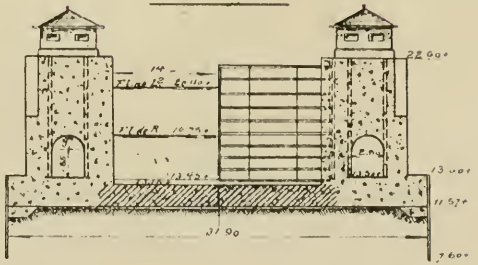


Section A B

Echelle 1:500



Section C D.



Béton

Béton armé

Béton = Concrete. — Béton armé = Reinforced concrete.

I. INLAND NAVIGATION

B. CANALS

JUNCTION CANAL FROM THE MEUSE TO THE WAHAL

The act of the 12th of June, 1913, authorised the canalisation of the Meuse between Maastricht and Grave (see map of the Meuse) and also *the construction of the canal linking up the Meuse near Mook and the Wahal near Nimègue*. The object of this canal is to join the Meuse to the large Dutch rivers; it may be considered as forming the continuation of the canalised Meuse.

The canal, including the fore-ports, will be 13 kil. 4 (8 3/8 miles) long. It will be accessible to the Rhenish boats of 2,000 tons, which are 100 m. (109 yds.) long, 12 m. (13 yds.) wide and have 2 m. 80 (9.1 ft.) draught; their emergency when empty reaches 6 m. 75 (22.13 ft.) maximum.

The dimensions of the locks, which will be provided with an intermediate head, will be established in prevision of the lockage of a train of boats comprising a tug and two 2,000 ton boats, the available length of these works will be of 260 m. (279 yds.), the breadth of the Wahal lock will be 14 m. (15.3 yds.) and 16 m. (17.5 yds.) that of the Meuse one, which will remain open during the greater part of the year, the mitre depth is 3 m. 80 (12.4 ft.).

The canal trench separating the two locks will be 40 m. (43.7 yds.) wide at the bottom with inclined slopes of 1/4. The depth will be 4 m. (13.1 ft.) in the axis and 3 m. 30 (10.7 ft.) at the sides below the minimum water line. The fore-ports will be 60 m. (65.6 yds.) wide at the bottom.

The fixed bridges will have openings of 60 m. (65.6 yds.). It is proposed to place draw-bridges at the locks. All these works will present a clearance of 7 m. (23 ft.) above the maximum water line.

The minimum radius adopted for the canal curves reaches 2,000 m. (2,187 yds.) and for the fore-ports 1,500 m. (1,640 yds.).

The dikes have a minimum breadth of 10 m. (10.9 yds.) at the top.

To facilitate navigation towards the fore-port of the canal, the bed of the Meuse, below Mook, will be transferred to a distance of 1,700 m. (1,860 yds.).

The works actually in course of execution will give rise to an outlay of 15 to 20 million florins including the expropriations. This expense will be borne by the State.

The construction of ports, landing and disembarking stages will be borne entirely by the boroughs and others interested in the matter.

Circulation on the canal will be free of all tolls.

It is presumed that this traffic will be very great.

WESSEM NEDERWEERT CANAL

The canal from Wessem to Nederweert actually in course of construction (1) will join the canalised Meuse near Wessem, 4 kilometres (2 1/2 miles) above the Linne weir, to the Zuid-Willemsvaart, near Nederweert.

Simultaneously with the construction of this canal, the Zuid-Willemsvaart will be deepened from Nederweert to lock n° 14, which will be demolished; the upper reach of the new canal will then extend from Nederweert to lock n° 13 of the Zuid-Willemsvaart.

Two locks will be built respectively above Nederweert and the Noordervaart for the junction with the Zuid-Willemsvaart.

The Wessem-Nederweert canal, of a total length of 17 kilometres (10 5/8 miles) will include two reaches, an upper reach in free communication with the Zuid-Willemsvaart (water line 78 m. 50+N. A. P.) and a lower reach for the junction with the canalised Meuse (maximum water line 23 m. 50+N. A. P. and a minimum water line 20 m. 40+N. A. P.).

A lock near Pannheel will compensate the minimum difference of level of 8 m. 10 (26.6 ft.) between the two reaches.

The width of the lock heads will be 7 m. 50 (8.2 yds.), the mitre depth 2 m. 50 (8 ft.), the length of the chamber 150 m. (160 yds.), its width 7 m. 50 (8.2 yds.).

As maximum dimensions of the 500 ton barges which will navigate on the canal, the following have been adopted : a length of 60 m. (65.6 yds.), a width of 7 m. (7.65 yds.), a draught of 1 m. 90 (6.2 ft.) and an emergency of 5 m. (16.4 ft.).

The normal width at the bed of the canal will be 16 m. (17.5 yds.), this width will be raised to 20 m. (21.8 yds.) in the curves of a radius less than or equal to 500 m. (547 yds.).

The depth will be 2 m. 50 (8 ft.) at both sides and 2 m. 70

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(1) See map of the canalised Meuse, p. 58.

(8.6 ft.) in the axis of the canal; the slope of the bank will be 1 : 3 below the water level and 1 : 2 above the same level.

When expropriating the necessary land the widening of the section was taken into account, in order that the canal might be accessible to the largest barges which will navigate in the canalised Meuse.

The protection of the banks will be of the same type as that of the Wilhelmina canal described in the « Notes on Works in progress or completed in 1913 ». (Belgium and Holland, p. 120.)

To realize a saving it is proposed to partially replace the system of protection by rush plantations.

For the inner-reach, which will communicate with the Meuse and which will have a variable level, the slopes will be covered, above the minimum water level, with a coat of clay covered with a stone stepping.

The water supply of the canal is only partially assured by the water from the Zuid-Willemsvaart. It will consequently be necessary to install a set of pumps at the Panheel lock to raise the waters of the lower-reach.

Only fixed bridges will be built on the canal.

The railway bridge for the Weert-Ruremonde railway will be built of steel, with a clearance of 5 m. 40 (17.7 ft.) over the entire width of the canal.

The road-bridges will be built of reinforced concrete, adopting a cantilever type with a clearance of 6 m. 2 (17 ft.) on a width of 16 m. (17.5 yds.).

All the bridges pass over the canal as well as the tow-path the railway bridge passes over the lateral dikes also.

The canal will, as we have already said, link the Meuse to the Zuid-Willemsvaart.

It being understood that the canalised Meuse will constitute in future the principal way for the transport of Limburg coal and that the Zuid-Willemsvaart with the corresponding Wilhelmina canal will pass through the industrial centres of Brabant, the Wessem-Nederweert canal is destined to facilitate the communications between the Limburg coal mines and these industrial centres.

Under this head a rather important traffic is expected, particularly in the transport of coal.

The costs of the execution of the works, exclusively borne by the State, were estimated in 1916 at 4 million florins, including the improvement works of the Zuid-Willemsvaart.

According to all probability, this estimate will be considerably exceeded, and the real amount for the works will be from 14 to 16 million florins.

(From information supplied, in September, 1920, by Mr. C. Heyning, Engineer at Ruremonde.)

TWENTHE-RHINE CANAL

The canal from Twenthe (Eastern part of the province of Overyssel) to the Rhine, will commence near Pannerden (the Wahal bifurcation) and will end at Enschede, passing through Vorden, Lochem, Goor and Hengelo.

Between Vorden and Lochem a junction canal to the Yssel near Zutphen has been provided for.

Besides this, the three following branches are foreseen: Goor to Almelo, Engelo to Borne and Enschede to Ondenzaal.

The length of the Rhine canal to Enschede is 83 kilometres (51 7/8 miles) that of the others is approximately 40 kilometres (25 miles).

The carrying out of the works was decided by the act of the 4th of November, 1919.

The object aimed at was in the first place to link the great industrial centres of Twenthe to the navigable water system; secondly, the portion of the canal comprised between the Rhine and the junction canal at Yssel will form with this latter watercourse a lateral canal which the large boats will use during the low water period, when the depth of the upper part of the river, though regularised, will not allow them to navigate. Between Zutphen and the Zuiderzee the Yssel is deeper.

The normal width of the bed of the canal will be 17 m. (17.5 yds.) and there will be veering basins. The depth will be 3 m. (9.8 ft.) in the axis and 2 m. 60 (8.1 ft.) at the sides, below the normal water level. The slope of the banks will be 4 : 1 below the water and then 3 : 1 and 2 : 1. The width at the water line will be 32 m. 60 (35.6 yds.), the water section will have a surface of 70.8 m2 (84.59 sq. yds.).

The proposed dimensions will allow of towing 600 ton boats; the possibility of a future enlargement for the traffic of 2,000 ton boats, has been taken into account.

The 600 ton boats generally have a length not exceeding 60 m. (65.6 yds.) a width of 8 m. (26.24 ft.) and a draught of 2 m. 40 (7.9 ft.).

In order to redeem the difference of level at Enschede the construction of four locks in the principal canal has been planned, three with a fall of 6 m. 25 (20.5 ft.) and one, near the Rhine, of a variable fall according to the level of the river.

The first reach is 67 kil. 7 (42.3 miles) long and the canal having, at Almelo, the same level as this reach of the principal canal, it will only be necessary to pass, between this locality and the Rhine, a distance of 81 kilometres (50 5/8 miles), one lock, the Rhine one.

The lock heads will have an entrance width of 8 m. 50 (9.2 yds.) and the mitre depth will be 3 m. (9.84 ft.). The chambers of the locks will be 16 m. (17.49 yds.) or 9 m. (9.84 yds.) wide according to the importance of the presumed traffic and 70 m. (76.5 yds.) long.

The locks with a fall of 6 m. 25 (20.5 ft.) will be provided with economy basins.

The future construction of a lock of smaller dimensions beside the big locks has been foreseen.

The bridges will generally be fixed bridges with 5 m. (16.4 ft.) clearance above the water level.

The feeding of the system will be carried out principally by the Rhine water by means of pumps to be placed at the right of the locks.

The provisional estimate for the works amounts to 28 million florins, according to 1914 prices.

The work will be carried out at the expense of the State with grants from the province of Overyssel, from the interested Boroughs and numerous participants (Societies, Manufacturers, Bankers, etc.); the law approving the construction of the canal requires a grant from those interested to the amount of 7.8 million florins.

The canal will be exonerated from all dues.

No conjecture is possible concerning the future development of the traffic; it is to be presumed that the latter will comprise more especially transports of coal, raw materials, building materials and perhaps also manure, because the districts crossed are not fertile.

(From information supplied, in August, 1920, by Mr. D. A. Van Heyst, *Ingénieur du Waterstaat, at the Hague.)*

Bibliography : See *De Ingenieur*, n° 41 of 1917, See also « Report of the 9th May of an Official Commission, Van Cleef, Spiu library, at the Hague. *Annales des Travaux publics de Belgique*, fascicule n° 4 of 1920.

II. OCEAN NAVIGATION

A. SHIP CANALS

CANAL FROM AMSTERDAM TO THE NORTH SEA

Works for the enlarging and deepening of the Canal from Amsterdam to the North Sea (see also IJmuiden harbour, p. 98), have been approved by the law of the 2nd of January 1917.

They have for object to appropriate the canal for the passage of the largest steamers by increasing the depth to 15 m. (49.2 ft.) below the low water mark and the breadth at the bottom to 100 m. (109 yds.) (see annexed transversal section).

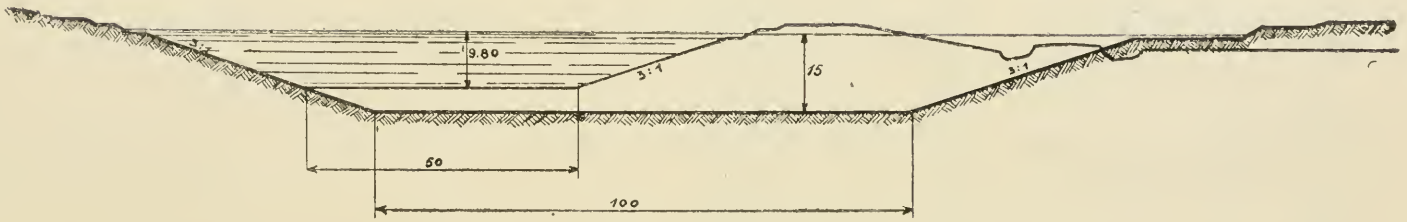
The estimate for the works, made out before the war, is 6,500,000 florins.

Two thirds of the expenses will be borne by the State and one-third by the Province of Northern-Holland and by the City of Amsterdam.

There are no toll dues on the canal.

(From information supplied, in August, 1920, by Mr. J.-C. Van den Broeck, *Ingénieur du Waterstaat, Vosiusstraat, 4, at Amsterdam.)*

Élargissement et approfondissement du Canal d'Amsterdam à la Mer du Nord.



Échelle 1 à 1000.

WATERWAY FROM DORDRECHT TO THE NORTH SEA

The existing maritime waterway from the North Sea to Dordrecht harbour, situated on the « Mallegat », is formed by the « Goereesche Zeegat », the « Haringvliet », the « Hollandsch Diep », the « Dordsche Kil » and the « Mallegat »; it is indicated by a thick black line on the adjoining map showing the whole of the tidal rivers in the region of Rotterdam and Dordrecht to a scale of 1 :100,000.

This old waterway does not answer any longer to the requirements of modern navigation; from time to time, sandbanks are formed in it, whilst in the « Goereesche Zeegat » particularly in the « Slykgat », the maintenance of a sufficient depth by dredging must be considered as impossible.

During the course of the last years, in normal times, one could only reckon on a depth of 60 decimetres (19.6 ft.) above high tide, so that Dordrecht harbour is no longer accessible to boats drawing 65 dcms. (21.3 ft.) which was originally the end in view.

But the great interest attributed by the Municipality of Dordrecht to through communication with the sea, especially after the construction (1914-1915) of the sea port, situated on the « Mallegat », was recognized by the Government, and the 15th of March, 1917, the latter presented the draft of an act for the construction of a maritime waterway from Dordrecht to the North Sea.

This draft was adopted and the 26th of April, 1918, the order

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Translation of French terms « planche n° C. »

Maritime waterway from Dordrecht to the North Sea by the Oude Maas

Passe navigable à construire présentant un mouillage minimum de 70 d.m. à marée basse (85 d.m. à marée haute) = Navigable channel to be constucted offering a minimum depth of 23 ft. at low tide 27.9 ft. at high tide). — Epis transversaux et digues longitudinales à construire, dont la crête s'élèvera à la cote de marée basse = Transversal groins and longitudinal dikes to be constructed, the crest of which will rize to low water level. — Lignes limitant le lit normal nouveau. = Line showing the limit of the new normal bed.

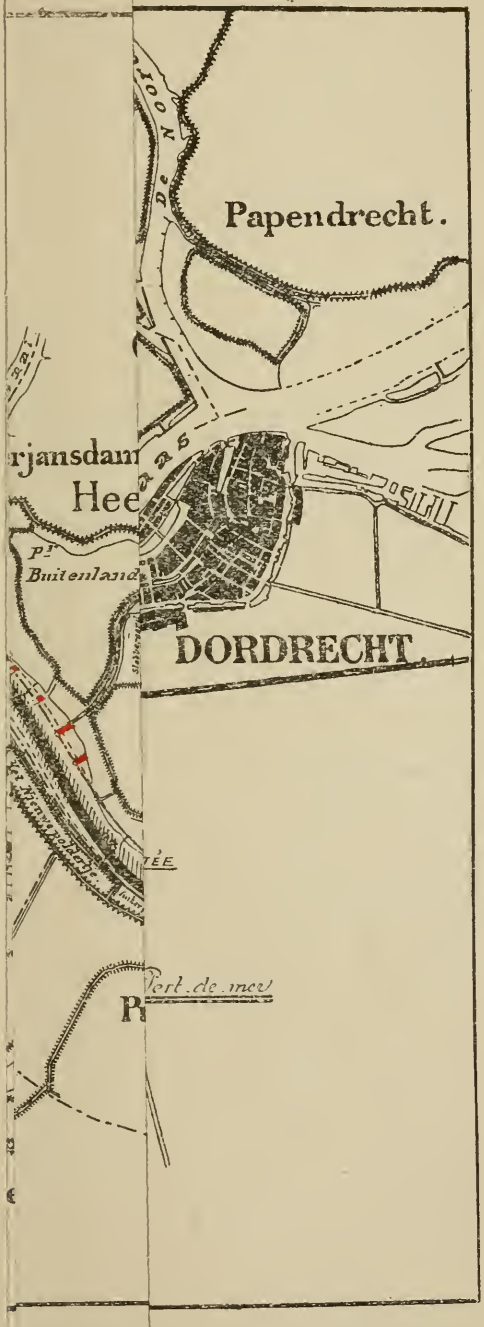
was given for the construction by the State of a maritime waterway, presenting at high tide a channel of 8 m. 5 (27.9 ft.) depth on a width of 50 m. (54.7 yds.) and a depth of 7 m. 50 (24.5 ft.) on a width of 100 m. (109 yds.). Then ships having a draught of 75 to 80 dcms. (23.5 to 26.2 ft.) will be able to ascend the waterway to Dordrecht and vice-versa.

The new maritime waterway will not be however realised by improving the existing waterway, that of the « Goereesche-Zeegat »; technical and military reasons being opposed thereto. It will be formed by the « Oude Maas » the regularisation of which will be completed to this end, and by the lower part of the Rotterdam riverway, called « Scheur », as the dotted line on the map shows to a scale of 1 : 25,000. The junction between the « Oude Maas » and the « Scheur » will be formed by the « Noordgeul » the turning of which in the South-Eastern-North-Western direction, is a part of the improvement works of the Rotterdam riverway in course of execution.

Another solution might have been suitable for the Dordrecht Maritime waterway, by adopting a line passing through the rivers « Noord and Nieuwe Maas (along Rotterdam); dredging of relative little importance would have been sufficient to this effect. But the solution had to be given up by reason of the inconvenience to navigation arising from the existence of two bridges with heavy traffic, to wit: a bridge on the « Nieuwe Maas » near Rotterdam and another on the « Oude Maas » near Dordrecht. It is true that two bridges likewise pass over the adopted line, but we are here speaking of tramway bridges, on which the traffic is much less important than on the railway bridges, of which we have just been speaking, and which impede navigation by the « Noord ».

The final plans for the maritime waterway to be constructed are being worked out. While awaiting the execution of the works, it has been necessary to remedy the inconvenience for navigation resulting from the pronounced curves in the portion of the navigable waterway « Oude Maas » (near Dordrecht) « Port Mallegat » by establishing a direct junction between this port and the « Oude Maas » across the Isle of Krabbe. This cutting will be accompagned by the closing of the « Mallegat » by dikes near the lower and upper mouths and the reopen-

PLANCHE Nº C.



VERBETERING VAN DEN WATERWEG VAN DORDRECHT NAAR ZEE
LANGS DE OUDE MAAS.
VOIE MARITIME DE DORDRECHT A LA MER DU NORD
PAR LA OUDE MAAS.

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CARTE des FLEUVES à suivre dans la région de DORDRECHT et de ROTTERDAM
KAART van de BENEDEN-RIVIEREN.
ECHELLE
Schaal 1 à 100000.
NOORD ZEE.
MER du NORD
VIANEN
ALBLASSERWAARD
PUTTEN
HOEKSCHE WAARD
BIESBOSCH
OVER-
SCHOUWEN
FLAKKEE
DUIVELAND

ing of the « Krabbe », blocked at the present moment. These works are marked on the maps by thick dotted lines.

It has been approved that the new maritime waterway should have a normal breadth of 150 m. (160 yds.) at the « Oude Maas » and the « Krabbe » branches; this width will increase regularly to 280 m. (299 yds.) above the mouth of the « Spui ». Below this mouth the width will be 200 m. (218 yds.) and will increase regularly to 260 m. (279 yds.) near the « Noordgeul ».

The top of the transversal groins, which will have to be built for the regularisation of the « Oude Maas » will rise to the low-tide level, so as to diminish ever so little the section of this river, which can be considered as the flux basin of the « Scheur ».

The quantity of sand to be raised by dredging is estimated at 6.5 million m3 (8 1/2 million cub. yds.). The dredgings will be deposited on grounds to be expropriated on the two banks.

The total cost of the works of the Dordrecht maritime waterway has been estimated, according to pre-war prices, at 4 million florins. To this amount must be added the cost of the transformation of the tramway bridge near Barendrecht which is estimated at 160,000 florins.

Under actual conditions, the execution of the works will cost more than double the estimates.

The works to be carried out by the State will only be started when those interested (the town of Dordrecht, the Chamber of Commerce, etc.), have taken upon themselves to intevene to the extent of 10 p. c. in the expenses.

(From information supplied, in 1920, by Mr. A. Marinkelle, *Ingénieur en Chef Directeur du Waterstaat, v. d. Spiegelstraat, 19, at the Hague.)*

Bibliography : See *De Ingenieur*, 1918.

See also *Annales des Travaux publics de Belgique*; fascicule 4 of 1920.

WATERWAY FROM ROTTERDAM TO THE NORTH SEA.

The maritime waterway between Rotterdam and the North Sea 35 kilometres (20 5/8 miles) in length, is formed by the rivers « Nieuwe Maas » and « Scheur » and by the cutting of the Hook of Holland, called « Doorgraving ».

The excavation works of this navigable waterway were begun in 1863. In 1896 the maritime waterway could be considered as finished with a depth of 65 decimetres (21.3 ft.) at low tide, as provided for at the commencement of the work, and which the passage offered on a sufficient width. This depth has been maintained by dredging, and at the river mouth two low jetties have been built, which extend as far as the desired sea depth.

But a little later, the 65 decimetres (21.3 ft.) depth at low tide in the navigable channel (75 decim. (24.5 ft.) at the mouth at low tide) no longer answered the new requirements of navigation. In view of satisfying these requirements, after 1896, the carrying out of important improvements were proceeded with, the last of which, approved by the act of May 1908, were finished in 1915. These works, which consisted, on one side, in deepening by

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Translation of French terms « Planche n° 1. »

Amélioration de la voie maritime de Rotterdam à la mer du Nord = Improvement of the maritime waterway from Rotterdam to the North Sea. avec rectification du fleuve en amont et en aval de Maassluis = with rectification of the river above and below Maassluis. — Passe navigable à construire présentant un mouillage minimum de 100 (80) dM. à marée basse 115 (95) à marée haute) = Navigable channel to be constructed offering a minimum depth of 32.8 ft. (26.24 ft.) at low tide (36.25 ft.) (31 ft.) at high tide). — Cette passe navigable sera approfondie régulièrement depuis le Krimsloot jusqu'à la ligne des fonds de 120 dM. à marée basse dans la mer = This navigable channel will be regulary deepened from Krimsloot to the low-tide depth at sea of 42.6 ft. — Epis bas transversaux à rehausser = Low groins to be raised, — Terrains destinés au dépôt des déblais = Land set aside for depositing dredgings. — Lignes limitant le lit normal nouveau = Lines limiting the new normal bed. — Digues longitudinales dont la crête s'élève à la cote de 4 m. — marée basse = Longitudinal dikes the crest of which rises to the level of 13.12 ft. below low water.

PLANCHE N° A.

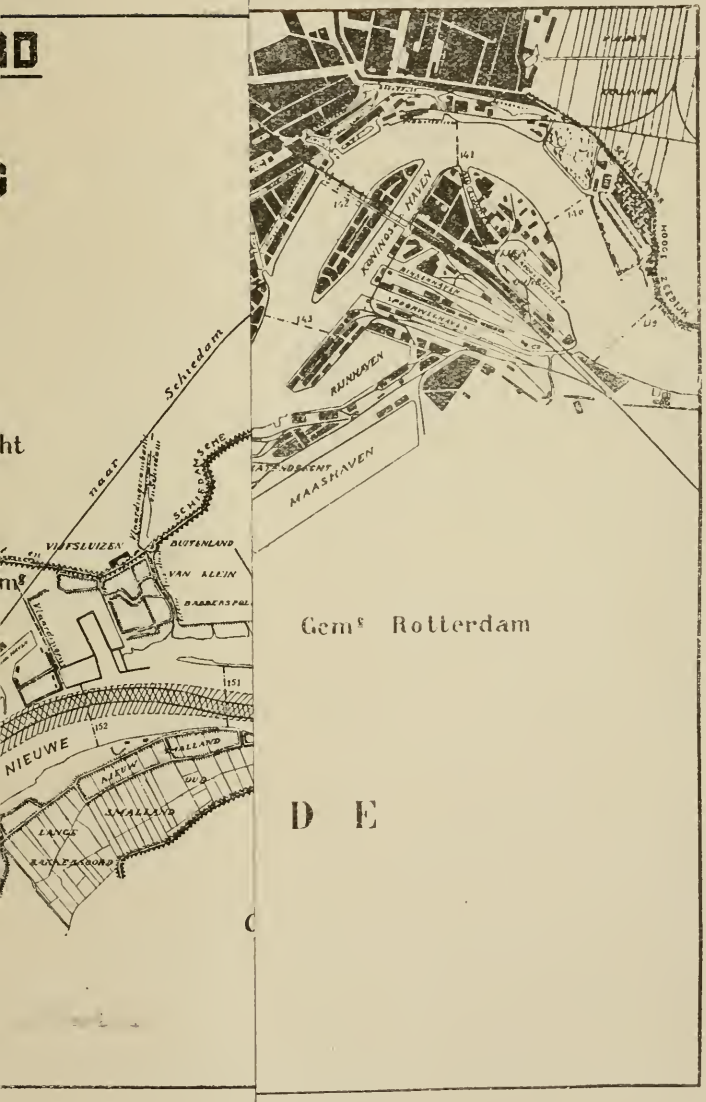
Schiedam
VIERSLUIZEN
BUITENLAND
VAN KLEIN
NIEUWE
HOLLAND
KONINGS HAVEN
RUNHAVEN
MAASHAVEN
Gem^s Rotterdam
D E

PLANCHE N°. 1

AMELIORATION DE LA VOIE MARITIME DE ROTTERDAM A LA MER DU NORD

AVEC RECTIFICATION DU FLEUVE EN AMONT ET EN AVAL DE MAASSLUIS.

VERBETERING VAN DEN ROTTERDAMSCHEN WATERWEG

MET RIVIEROMLEGGING BOVEN EN BENEDEN MAASSLUIS.

dredging some sections of the navigable channel, which did not afford the necessary depth, and, in part, in prolonging the jetty south of the mouth in a S. W. direction, resulted in the creation of a continuous channel of a minimum breadth of 150 m. (160 yds.) with a minimum depth of 8 m. (26.2 ft.) below low tide (9 m. 50 (31 ft.) at high tide) thus on a width of about 100 m. (109 yds.) a depth of about 8 m. 50 (28 ft.) below low tide (10 m. (32.8 ft.) below high tide). An important improvement has also been realised at the river mouth, and at high tide large ships drawing 9 m. 30 (29.5 ft.) have been able to navigate on the maritime waterway in both directions between the North Sea and Rotterdam.

Because of the increase in the size of the transatlantic liners Parliament voted a Bill the 2nd of January 1917, approving a number of improvement works in view of rendering Rotterdam accessible, at high tide, to ships having a draught of 12 m. 20 (40 ft.), which means increasing the necessary depth to 12 m. 50 (41 ft.) at high tide or 11 m. (36 ft.) at low tide.

A channel offering a depth of 11 m. 50 (37.7 ft.) only at high tide or 10 m. (32.8 ft.) at low tide must however be sufficient to begin with, although, to reckon with the pitching of the ships when the sea is rough, the depth at the mouth of the river will be brought to 12 m. 50 (41 ft.) below high tide level.

The width of the channel offering a minimum depth of 37.7 ft. at high tide, has been fixed at 100 m. (109 yds.) whilst a minimum depth of 9 m. 50 (31 ft.) will be obtained on a breadth of 200 m. (218 yds.). This breadth will go on increasing from the « Krimsloot » up to the mouth.

The works which have just been outlined are in course of execution; they include:

a) The dredging of a volume of about 8 million m3 (10,200,000 cub. yds.) estimated at 2.5 million florins according to pre-war prices.

b) *The regularisation works to be continued in the section of the river « het Zuiden » extending between Poorterhaven and Krimsloot by means of raising the existing groins.* The cost is estimated at the sum of half a million florins.

c) *The deviation of the « Noordgeul »* in the S. E.-N. W. direction to turn the « Oude Maas » from its proper course towards

the « Scheur » and realize an increase in the force of the tides in the lower part of the maritime waterway. The cost of the works for the « Noordgeul » has been estimated at half a million florins.

d) Finally, later on a *radical rectification of the navigable channel below and above « Maassluis »* will be executed. The object of this will be to remedy the inconvenience resulting to navigation (especially for big steamers) from the fact of the existence, at the place mentioned, of two pronounced curves.

These two curves will be replaced by a curve with a large radius, which will require the expropriation of vast zones of land on both banks. The cost of the rectification of the river above and below « Maassluis » has been estimated at the sum of 5 million florins, according to pre-war prices.

The total costs of the works, decided by the law of the 2nd of January, 1917, including the necessary expropriations and unforeseen expenses, have been estimated at 9 million florins.

The greater part of these expenses will be borne by the State, the municipality of Rotterdam however has declared its readiness to contribute for one third in the sum of 5 million florins, which was the estimate for the original scheme of works.

It is quite probable, considering actual prices, that the real cost will sensibly exceed the estimate made before the war.

The adjoining map shows the whole of the works which are in course of execution; the grounds destined for the deposit of dredgings are indicated by hatching.

(From information supplied, in 1921, by Mr. Marinkelle, *Ingénieur en chef, Directeur du Waterstaat, v. d. Spiegelstraat, 19, at the* **Hague.**)

II. OCEAN NAVIGATION

B. SEA PORTS

PORT OF DELFZIJL

The proposed enlargements include:

a) *a new port entrance.*

b) *an outer harbour* intended for pilot boats, tugs and mail steamers of small draught.

c) *an extension of the surface set apart for vessels of great draught.*

d) lengthening of the quays for these boats;

e) a port for the temporary storage of beams.

The port of Delfzijl is situated on the left (Dutch) bank of the river Ems opposite the port of Emden.

The actual depth is 7 m. 35 (24.11 ft.) below low tide (9 m. N. A. P.) the tidal amplitude is 2,75 m. (9 ft.). The principal business of the port consist in the importation of timber from Baltic ports.

The object of the enlargement is:

1) To better protect ships against the action of the swell, by surrounding the port with a dike, the top of which will be raised above the highest storm tides;

2) To diminish the filling up with mud of the existing harbour,

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Translation of French terms p. 88.

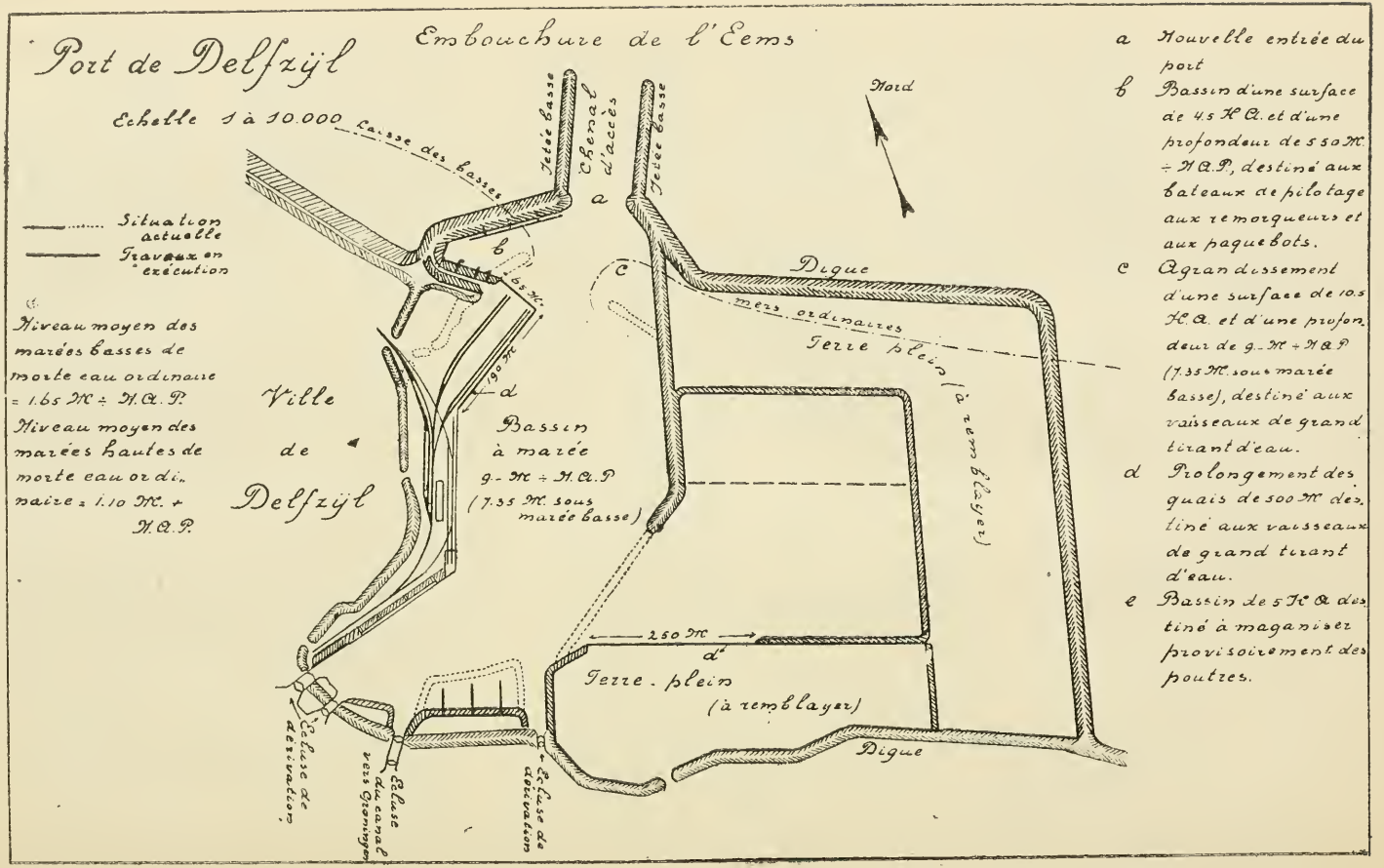
Embouchure de l'Ems = Mouth of the Ems. — Chenal d'accès = Entrance channel. — Jetée basse = Low jetty. — Situation actuelle = Actual situation. — Travaux en exécution = Works in progress. — Niveau moyen des marées basses de morte eau : 1.65 m. + N. A. P. = Average level of ordinary low neap-tide : 5.4 ft + N. A. P. — Niveau moyen de marées hautes de morte-eau ordinaire : 1.10 m. + N. A. P. = Average level of ordinary high neap-tide: 3.6 ft. + N. A.P. — Bassin à marée = Tidal dock. — Digue = Dike. — Terre-plein (à remblayer) = Platform (to be filled up). — Ecluse de dérivation = Derivation lock.

a) New port entrance. — *b*) Dock of an area of 12.11 acres, with a depth of 18 ft. + N.A. P.,for pilot boats, tugs and steamers.— *c*) Enlargement by a surface of 25 acres with a depth of 29.5 ft. + N. A. P. (24.11 ft. below low tide) for large ships. — *d*) Lengthening of the quays by 547 yds. for large ships. — *e*) 12 acre dock for temporary storage of beams.

N. A. P. = Nieuwe Amsterdamsche Peil = New Amsterdam O.

Port de Delfzijl

Embouchure de l'Ems



a Nouvelle entrée du port

b Bassin d'une surface de 4.5 H.a. et d'une profondeur de 5.50 M. ÷ N.A.P., destiné aux bateaux de pilotage aux remorqueurs et aux paquebots.

c Agrandissement d'une surface de 10.5 H.a. et d'une profondeur de 9.- M ÷ N.A.P. (7.35 M. sous marée basse), destiné aux vaisseaux de grand tirant d'eau.

d Prolongement des quais de 500 M. destiné aux vaisseaux de grand tirant d'eau.

e Bassin de 5 H.a. destiné à magasiner provisoirement des poutres.

which is important, by prolonging the entrance passage lined with low jetties, as far as the deep channel of the Ems;

3) To increase the total surface of the docks intended for the anchorage of ships having considerable draught from 16 hectares to 39 (39 acres to 96);

4) To prolong the length of quays intended for berthing ships having a large draught by 260 m. and 765 m. (283 and 835 yds.);

5) To create a special dock for ships importing wood, of which a part is intended for ships having a large draught and to establish a dock of 5 hectares (12 acres) (see plan) to receive the beams and to store them temporarily;

6) To create, near the port entrance, a special dock of an area of 4 hectares 50 (12.11 acres) for pilot boats, tugs, and small mail steamers.

* * *

The estimated price of the works is 4,000,000 florins (1916 prices).

The expenses are borne by the Dutch Government and by the province of Groningue, the latter participates to the extent of 1 10 of the expenses.

(From information supplied, in July, 1920, by Mr. J. P. Wijtenhorst, *Ingénieur en chef du Waterstaat, Furfsinger, 16, at Groningue.)*

Bibliography : See *De Ingenieur*, N° 38 of 1917, 44 of 1918, 24-35-52 of 1919. See also *Annales des Travaux publics de Belgique*, fascicule N° 3 of 1920, and the statement by the Commission appointed by the Minister of the Waterstaat in view of examining the means of improving and enlargening the port of Delfzijl. January 1917 (not published).

PORT OF ROTTERDAM

1° New docks to the West of Delfshaven.

Dock called « Konshaven » finished in 1912 of 1 H. A. (2.47 acres) surface.	Industrial harbour with slopes.
Dock called « Keilehaven » finished in 1913 of 6 H. A. (14.8 acres) surface.	Depth 4 m. (13.12 ft) below low tide.
Dock called « Ysselhaven » finished in 1914 of 6 H. A. (14.8 acres) surface.	Commercial harbour with quay walls 3,100 m. (3,390 yds.) long.
Dock called « Lekhaven » finished in 1915 of 9 H. A. (22.2 acres) surface.	Depth below low tide 10 m. (32.8 ft.)

The object of these works was to extend the maritime docks and quays having a depth of 10 m. (32.8 ft.) below low tide and, besides, to build two industrial docks with 4 m. (13.12 ft.) depth below low tide.

The works, including the acquisitions of land, cost 12,150,000 florins.

This expense was entirely borne by the city of Rotterdam.

The receipts accruing from the letting of ground situated along the quays amount to 645,000 fl. a year; besides this a quay toll is levied.

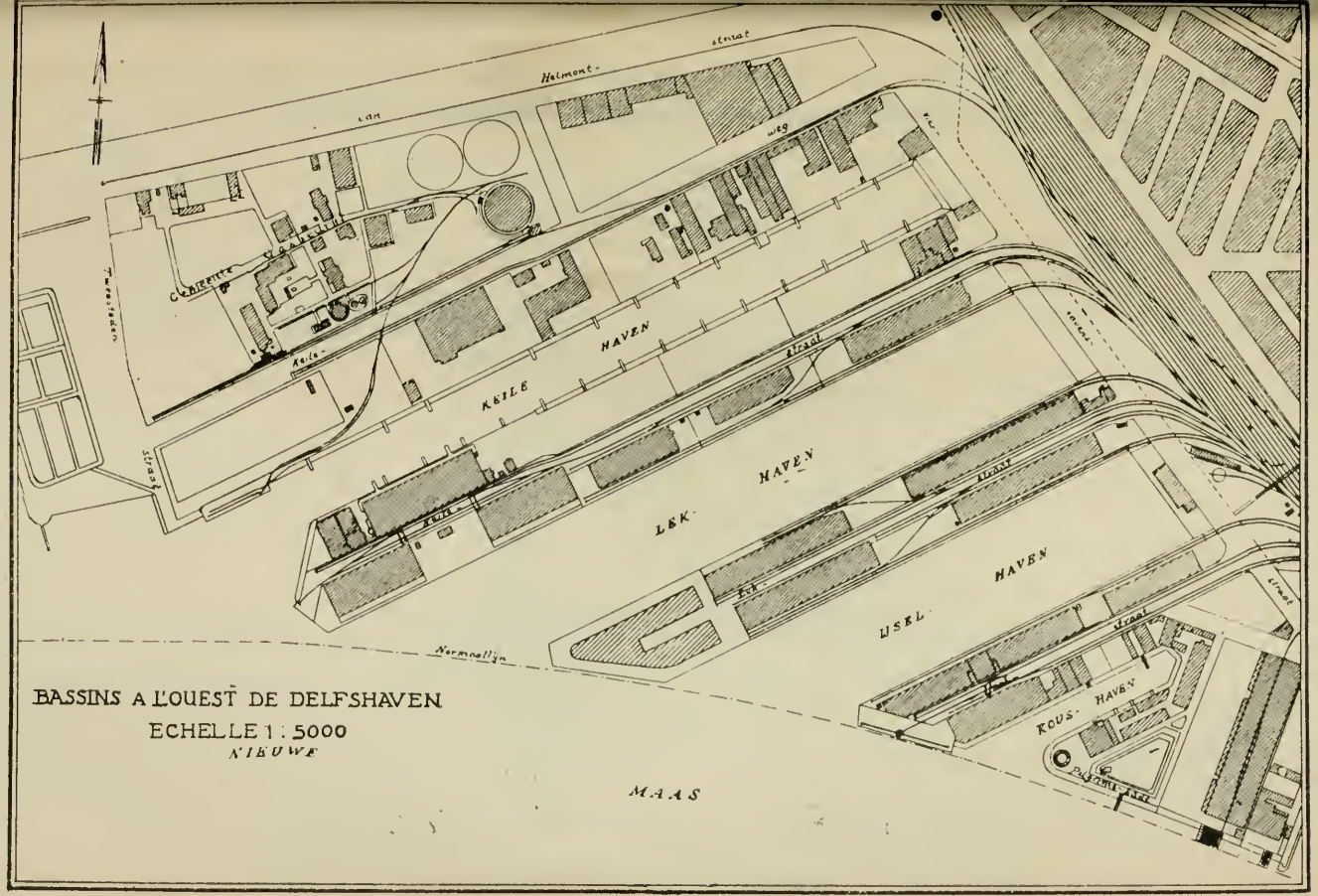
The grounds in question are let to several firms for a long term.

It is difficult to say what share is due to the new docks in the increase of traffic.

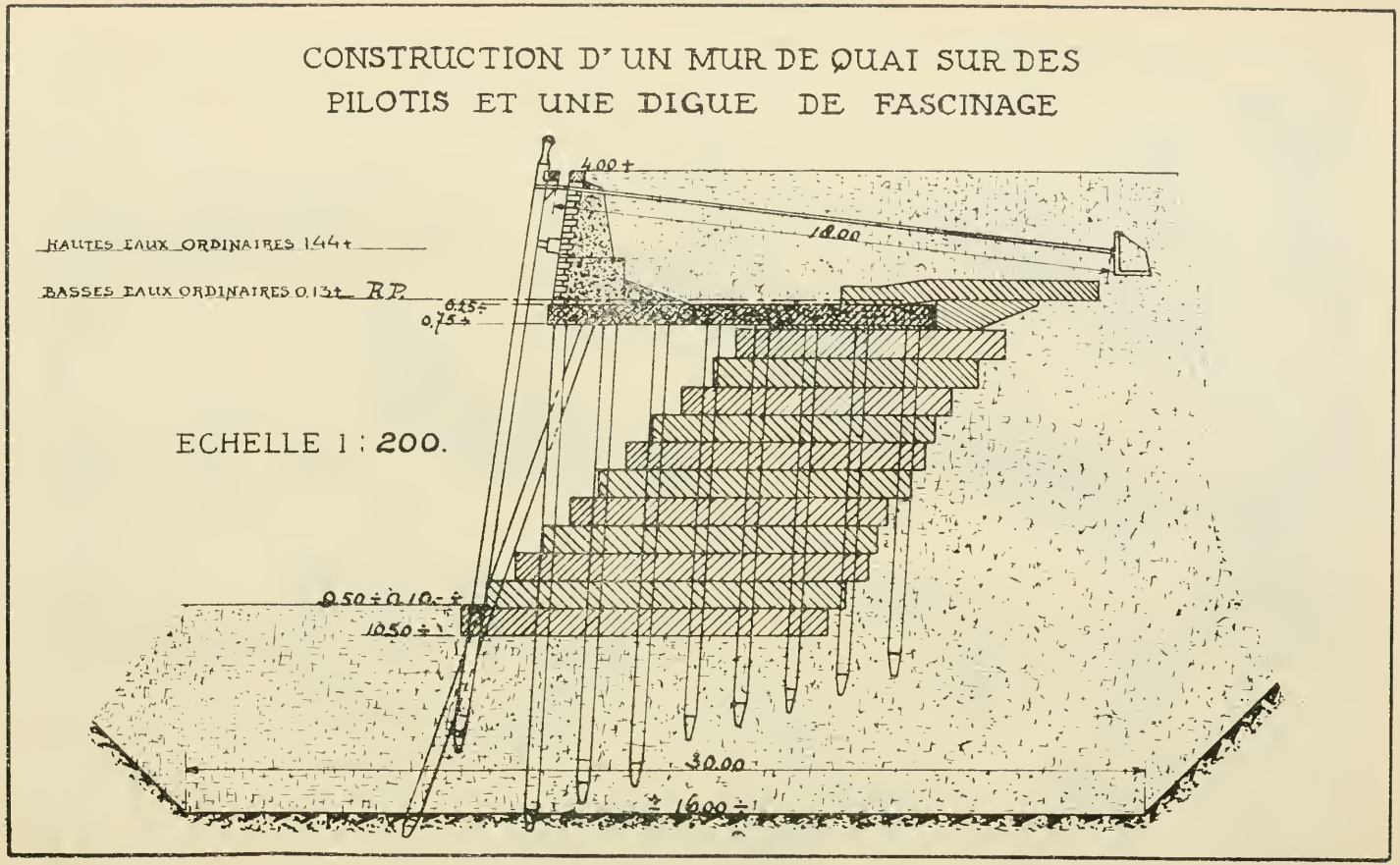
The expenses for the carrying out of the works were estimated at 7,625,000 florins. Supplementary works have still to be carried out.

2° Scheme for enlarging the « Waalhaven ».

The existing dock, of which the construction began in 1907, has a surface of 95 hectares (235 acres); after the proposed enlargement, its surface will be 260 hectares (642 acres) (not including the area of the piers). Its depth will be 10 m. (32.8 ft.) below low tide.

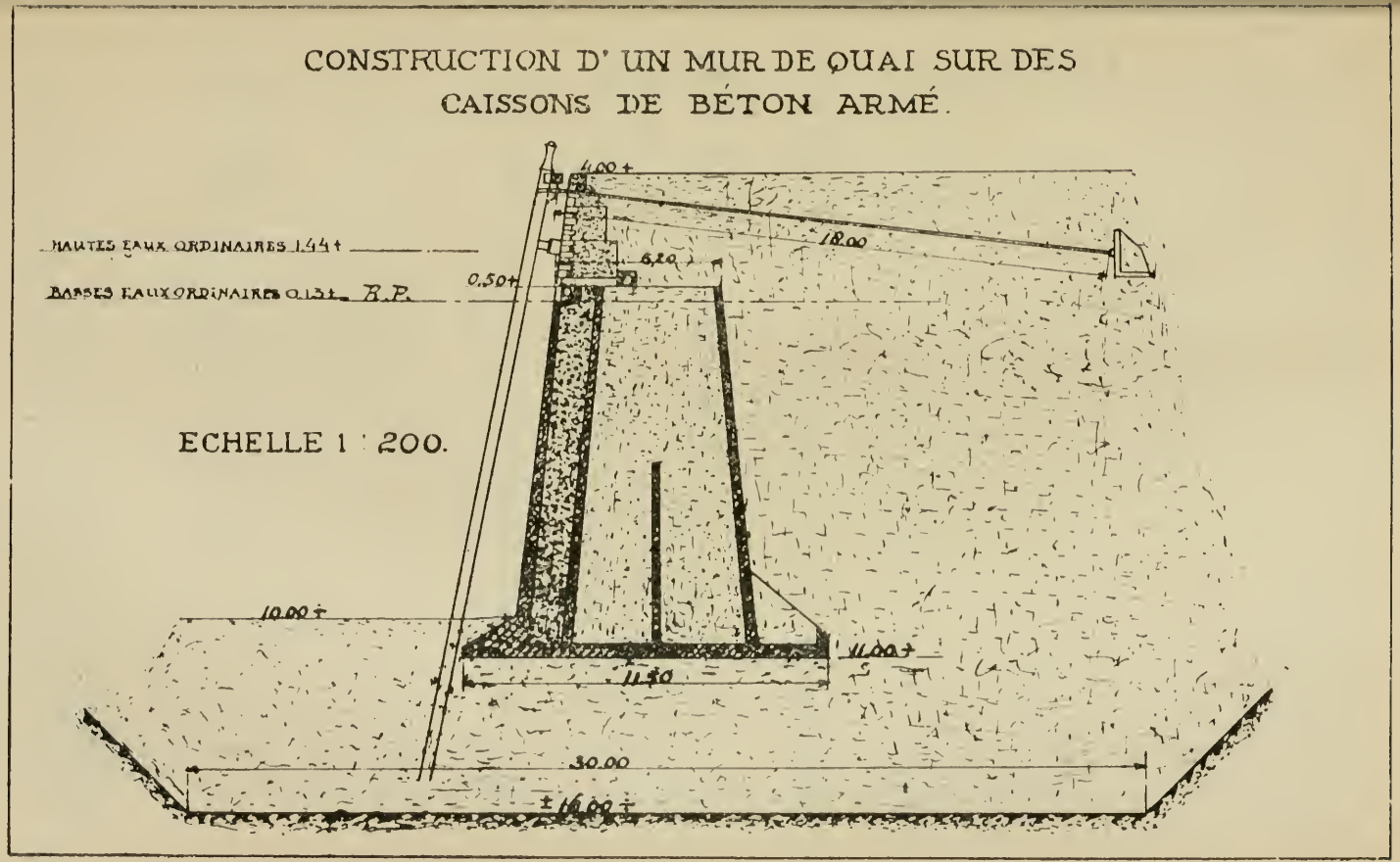


Docks to the west of Delfshaven.



Construction of a quay-wall on piles and a fascine work dike.

Hautes eaux ordinaires = Ordinary high water. — Basses eaux ordinaires = Ordinary low water,



Construction of a quay wall on ferro-concrete caissons.

By the establishing of piers (see plan) wharves of a great length will be available.

The expenses will be entirely borne by the city of Rotterdam.

The rent of the platform of a quay of 60 m. (65.6 yds.) length has been fixed at 2 florins per m2 (10.76 sq. ft.) and per year.

For the platforms of more of 60 m. (65.6 yards) length, the ground beyond that length will be let at 1 florin per m2 and per year. The piers to be built on the West and East sides of the « Waalhaven » will be let yearly for 1.90 florin per square metre.

A riparian piece of ground, provided with a stone stepping will fetch an annual rent of 1 florin per m2 and per year whatever its length may be. To appreciate these figures one must not forget that after twenty-five and fifty years, the rent will be increased conformably with the prices which will be in force then.

Moreover the City levies quay tolls.

3° Maritime docks planned to the West of the « Waalhaven »

(left bank of the Meuse)

The expropriation Bill for the carrying out of these works is dated 1st of December, 1917.

The total surface of the new docks will be approximatively 600 hectares (1,482 acres). These works have not yet been commenced.

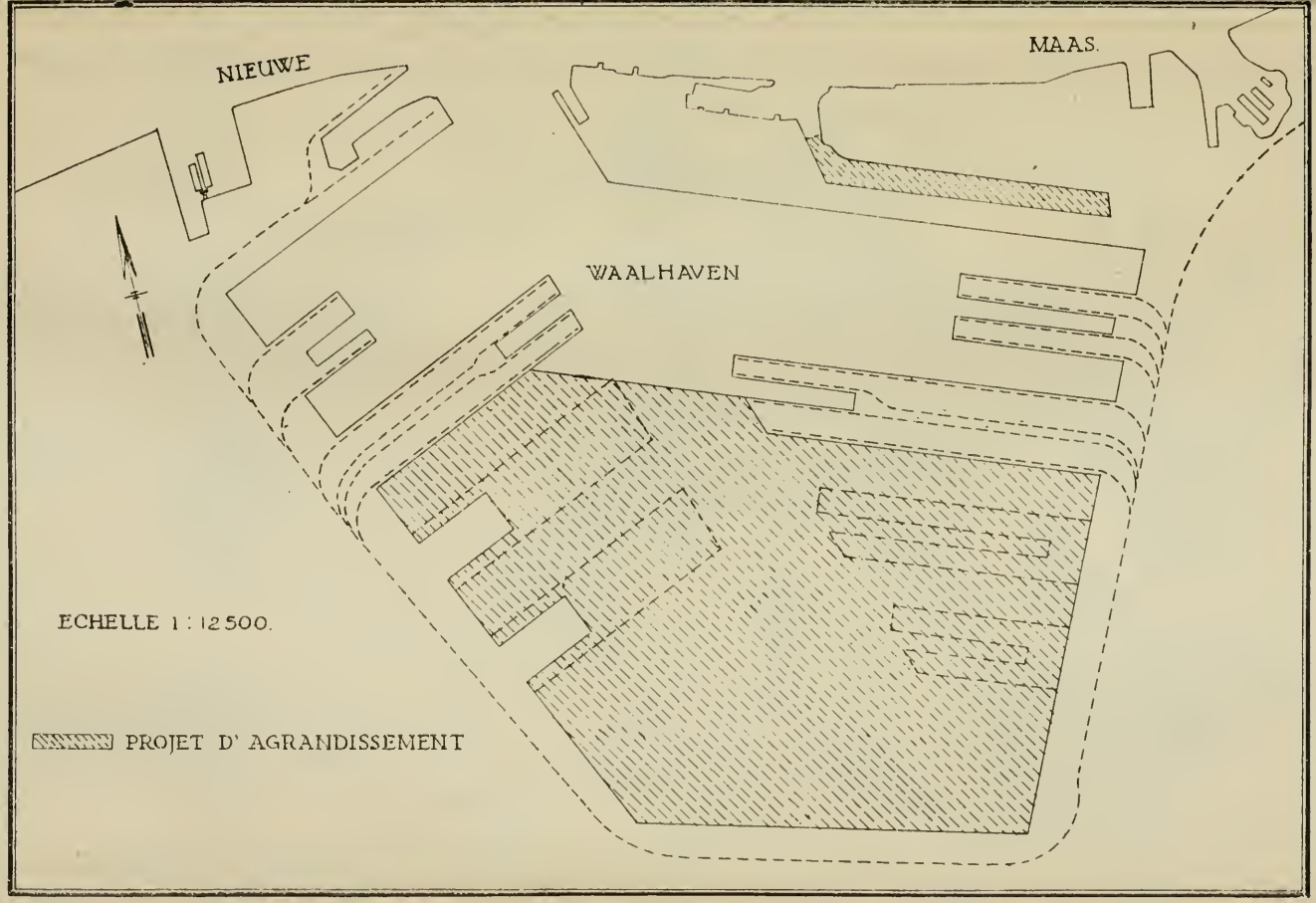
Inland navigation canals proposed on the right bank of the Meuse (see map).

These canals for boats of 2,400 tons will be 3 m. (9.84 ft.) deep and have a total length of 5 kilometres (3 1/8 miles).

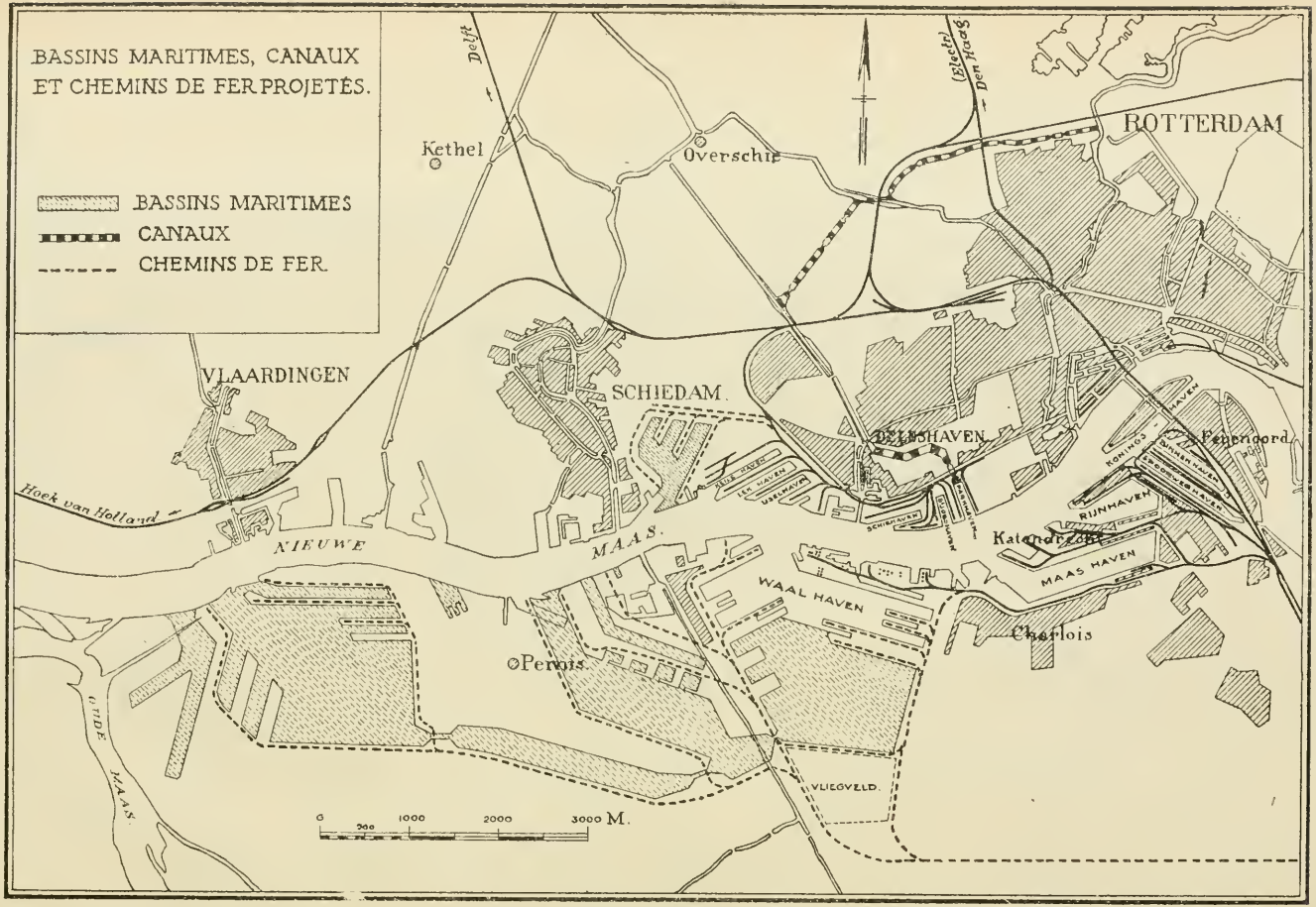
The cost has been estimated, at pre-war prices, at 11 million florins; it will be borne by the City of Rotterdam.

(From information supplied, in June, 1920, by Mr. H. S. DE ROODE, *Directeur-adjoint des Travaux publics, Stadstimmerhuis, Haringvliet, 4, at Rotterdam.)*

Bibliography : Dock works to the West of the « Delfshaven »: *De Ingenieur*, N° 26, of 1912.



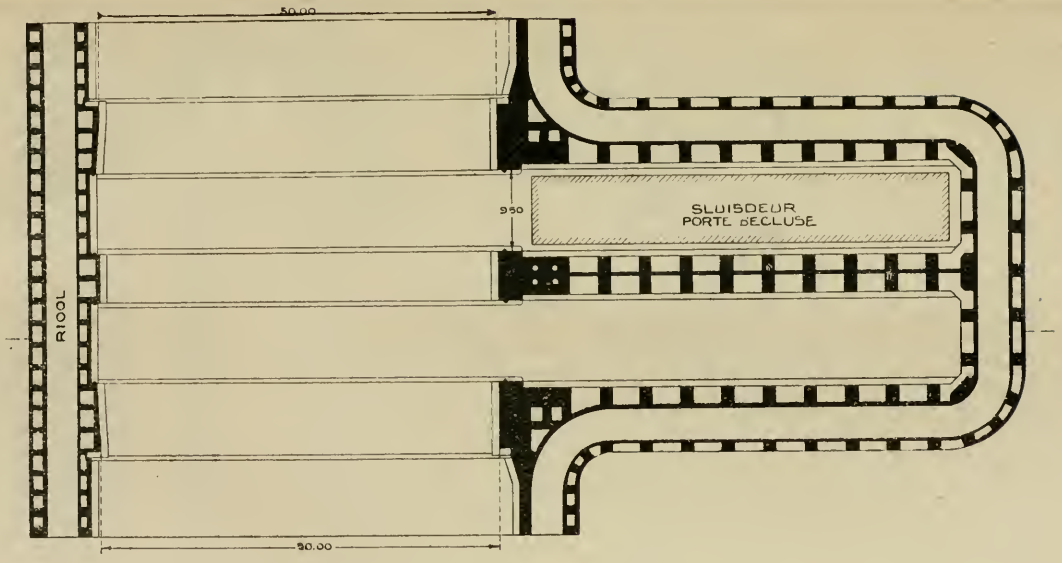
Proposed enlargement.



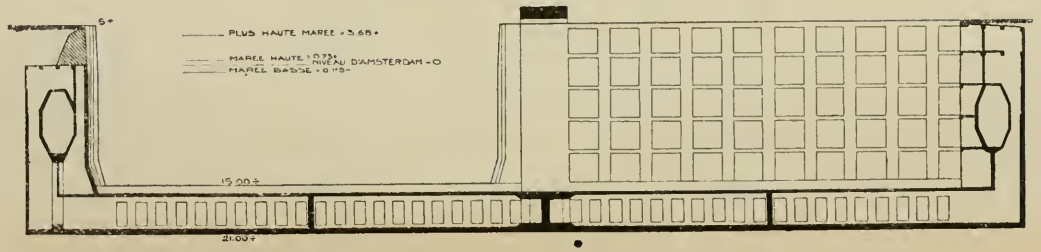
Proposed docks, canals and railways.

Bassins maritimes = Docks. — Canaux = Canals. — Chemins de fer = Railways.

Plan d'une tête d'Ecluse.



Section transversale de la tête d'Ecluse.



Plan of a lock head

Porte d'écluse = Lock gate. — Cross section of the lock head.

PORT OF IJMUIDEN

The port works which were started in 1920 include *the construction of a maritime lock* of very large dimensions (400 × 50 m.) (437 × 54.7 yds.) with its access channels, forming so to speak a branch of the North Sea canal from the bridge of Velsen to the existing outer harbour, where it will empty itself, till the time when a new outer harbour, also foreseen, will be built.

At the same time, the enlargement of the North Sea Canal from Amsterdam to the Velsen bridge will be proceeded with.

The object of these works is to facilitate the access to Amsterdam harbour of ships of the largest sizes, having however a draught limited to 14 m. (45.8 ft.) considering the depth of the North Sea in the neighbourhood of IJmuiden, which would not allow, without rather exagerated costs, of prolonging the moles further than the line of 15 m. (42.2 ft.) depth below the Amsterdam level (half tide).

The carrying out of the works had become urgent since the main part of the Amsterdam traffic was worked by only one of the existing locks, the other having become too small for the greater part of the ships frequenting this harbour.

The contemplated lock for ships having a draught of 14 m. (45.8 ft.) at half tide, will have its sill at 15 m. (49.2 ft.) below the Amsterdam level, a lock chamber of 400 m. (437 yds.) length and lock heads presenting like the lateral walls, a free passage of 50 m. (54.7 yds.).

The works will be built on reinforced concrete caissons of the current type for the lateral walls, and constituting floating bodies for each of the heads.

The foundation soil, which consists of thin sand, will be prepared, by means of a bucket dredger, making it pass often in order to suppress all the irregularities of the soil. The lock will be provided with rolling gates, two for each head, on of them being kept as reserve.

The thickness admitted for the big caissons below the sill is 6 m. (6.56 yds.). It will be possible to inspect, in the dry, the sills by using the two gates as a coffer dam.

REINEN
DE
Hauts-
GOVENS".
aux.
GEM
400 x 50 m.
HOOGROZEE

BOUW EENER SCHUTSLUIS C.A. TE YMUIDEN

OVERZICHTSKAART

Ecluse d'Ymuiden.
Plan général

The bottom of the lock chamber will only be covered with a layer of unrammed concrete of slight thickness.

A general plan and a plan of one of the proposed lock heads are given herewith.

The cost of the works, estimated at first at a sum of 13 million florins, with the forseen changes, will reach about 15 millions, pre-war prices.

At the actual prices, the cost of the lock works, including the entrance channel and the expropriation of grounds, will be from 39 to 40 million florins.

The expenses will be borne by the State with the participation of the Province of Northern Holland (Noord-Holland) for 5 5/9 p. c. and by the City of Amsterdam for 27 7/9 p. c.

Navigation on the State canals being free the direct returns to be obtained from the increase of traffic will be nil.

(From information supplied, in September, 1920, by the Jonkheer C. E. W. VAN PANHUYS, *Ingénieur en Chef du « Rykswaterstaat », Entrusted with the construction of the new IJmuiden lock.)*

Bibliography : See *De Ingenieur*, N° 39, of 1920. See also: *Annales des Travaux publics de Belgique*, fascicule N° 6 of 1920.

INDEX

BELGIUM

1. INLAND NAVIGATION

a) Free running and canalised rivers

The river portion of the Scheldt 5

Extension works on the intermediate reach at Ghent (3rd section) : Demolition of the Pêcherie lock, replacement of the swing bridge called « de la Pêcherie » by a lifting-bridge, improvement of the Pêcherie canal on the right side of the lock to be demolished.

Straightening, widening and deepening of the Scheldt, between the Berchem and Audenarde locks.

Straightening, of the Scheldt in the province of Hainant below Kain Island.

Building of five new locks with weirs on the upper Scheldt between Tournai and Ghent, at Kain, Espierres, Berchem, Audenarde and Asper.

The Lys 9

Works for the improvement of the river between the derivation canal called « de Schipdonck » and the Astene lock.

Straightening, widening and deepening of the river between the Snep bridge and the municipal shooting range, at Ghent.

Improvement works of the upper Lys, between Menin and Courtrai, establishment at Menin of a derivation, construction of a new weir with lock and a fixed bridge.

Creation of a canal from the Scheldt to Mouscron.

The Meuse 11

Lowering of the level of the water stratum.

Building of large locks to be placed against the existing ones on the Meuse at Ben-Ahin, Awirs, and Jemeppe.

Construction of a new lock to be placed against the existing one on the Meuse, at Andenelle.

Normalization, at the same part of the Meuse between the Andenne bridge and the « Rieudotte » brook.

The Sambre 13

Construction of a new lock to replace the actual one at « Jambe-de-Bois ».

b) Canals

Antwerp-Rhine, Antwerp-Campine-Liége and Brabant canals . . 17
The Antwerp-Meuse-Rhine canal ; Campine colliery canal ; Liége-Lixhe-Genck canal ; Brabant canals.

Charleroi-Brussels canal 22
Improvement of the part of the canal situated below Clabecq

Branch canal towards Turnhout 24
Reconstruction of seven swing-bridges.

Liége-Maastricht canal 25
Construction of timber-fenders.
Transformation and lengthening of lock n° 2 at Haccourt.

Maastricht-Bois-le-Duc canal 26
Improvement works.

II. OCEAN NAVIGATION

a) Tidal rivers.

The maritime portion of the Scheldt 29
Strengthening of the quay-walls along the Scheldt, at Antwerp.
Dredging of the maritime portion of the Scheldt below the mouth of the Rupel.
Improvement of the maritime portion of the Scheldt between the Jabeke pass and the Berlaere-Schoonaerde bridge.

b) Ship Canals.

Ship canal from Ghent to Terneuzen 33
Reconstruction of the quay wall situated on the right bank of the canal, between the outer harbour and the Meulestede bridge at Ghent.
Establishing of a large dry dock in the upstream part of the old arm called « Langerbrugge ».

c) Sea Ports

Port of Antwerp (see also maritime portion of the Scheldt). . . 37
Construction of the Southern portion of the canal dock and of the two corresponding wet docks.
Construction at Kruisschans of a sea lock and of its entrance channel.

Port of Nieuport 39
Restoration and reconstruction of locks and weirs at the inner port of Nieuport.

Port of Ostend 42
New fishery installations, to be made on the East bank of the channel of the port.

Port of Zeebrugge 44
Tidal basin to be established for the use of fishing boats.

HOLLAND

I. INLAND NAVIGATION

a) Free running and canalised rivers

The Meuse 49
Canalisation from Maasbracht to Grave. Linné weir and lock.

b) Canals

Junction canal from the Meuse to the Wahal 67
Construction of the canal.

The Wessem-Nederweert canal 69
Construction of the canal.

The Twenthe-Rhine canal 72
Construction of the Canal.

Canals for inland navigation planned on the right bank of the Meuse. 94

II. OCEAN NAVIGATION

a) Ship canals

Canal from Amsterdam to the North Sea 77
Widening and deepening of the canal.

Waterway from Dordrecht to the North Sea 79
Construction of the waterway.

Waterway from Rotterdam to the North Sea 82
Realization of a depth of 12.50 m. (41 ft.) at high tide : Regulation between Poortershaven and Kruisloot; Turning of the « Noordgeul » : rectification of the channel below and above the Maassluis.

b) **Sea Ports**

Port of Delfzijl 87

New entrance. Creation of an outer-harbour; Extension of the surface intended for vessels having a large draught; Lengthening of the quays; Port for the storage of beams.

Port of Rotterdam 90

New docks to the West of the « Delfshaven »; Scheme for enlarging the « Waalhaven »; Maritime docks planned to the West of the « Waalhaven » (Left bank of the Meuse).

Port of IJmuiden 98

Construction of a maritime lock. Widening of the North Sea canal.

Translated by E. Leeds, The Live School, 12, rue de l'Enseignement, Brussels.

Permanent International Association

OF

NAVIGATION CONGRESSES

WORKS CONNECTED WITH OCEAN

AND

INLAND NAVIGATION

FRANCE,

ALGERIA, CORSICA, MADAGASCAR, SENEGAL

AND THE

PRINCIPALITY OF MONACO

Notes on the works approved or completed in 1920

Executive Comittee — Office of the Secretary General
38, rue de Louvain, 38
BRUSSELS

FRANCE

I. INLAND NAVIGATION

A. FREE RUNNING AND CANALIZED RIVERS

THE RIVER LOIRE

Works for improving the navigability of the Loire between Montjean and Nantes.

The object of these works is to obtain a minimum depth of 1 m. 50 (4 ft. 11 in.) below the mean low-water mark on the sills, this mean low-water mark being about 0 m. 30 (1 ft.) above the lowest water known.

The cost is entirely supported by the State. The works decided on in principle and which include the improvement of the navigability between Montjean and the up stream limit of the works of improvement of the port of Nantes, thus on a length of 40 kilometres (25 miles), will entail an expense, calculated at actual prices, of about 10 to 12 million francs.

It is probable that the annual traffic which, in 1919, was only 29,369 tons for the whole distance, will be increased, when water communication will be constantly possible between Nantes and Angers, to 300,000 tons.

(From information supplied, in May, 1920, by Mr. KAUFFMANN, *Ingénieur en chef des Ponts et Chaussées, 2, Place de l'Edit de Nantes, Nantes.)*

Bibliography : La Loire et le Port de Nantes, by KAUFFMANN, Ingénieur en chef des Ponts et Chaussées. *Annales des Ponts et Chaussées*, 1915, vol. V, p. 164.

Works connected with Ocean and Inland Navigation in 1913. The River Loire, p. 5.

THE RIVER MARNE

Construction of a Port at Bonneuil, on the Marne, and works for the improvement of the Marne, between its confluent, at Charenton, and the Port of Bonneuil.

The weir lock of Saint-Maurice-Alfort, on the Marne (1), was in course of construction at the beginning of the war. Momentarily stopped by the mobilisation, the works were recommenced and pushed on with activity and the weir was completed on the 6th of June, 1916.

The Saint-Maurice-Alfort lock has a length of 125 m. (136 yds.) and a width of 12 m. (13 yds.).

The putting of this work into service allowed of creating during the war, at Bonneuil, an important inland port connected with the Est railway system where were transhipped or stocked quantities of goods destined for the armies, for war material, for the national food supply or for industry.

An entrance channel was excavated by means of dredging in the bed of the Marne from its confluence with the Seine as far as the proposed port : this was given a width of 30 m. (32.8 yds.) and a depth of 2 m. 20 (7.2 ft.) below the normal level.

Further the Créteil lock which had an available length of 45 m. only and a width of 7 m. 80 was lengthened and widened so as to increase these dimensions to respectively 55 m. (60.2 yds.) and 8 m. 20 (10 yds.).

These works were performed without interrupting the navigation.

The yield from the dredging of the entrance channel, formed for the larger part of gravel, served to make the platform of the port which it was thus possible to establish above the level of ordinary high waters.

The whole length of the port the banks were given a slope of 45° and protected, between the normal level of the river and that

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(1) See « Works connected with Ocean and Inland Navigation in 1913, » p. 6.

of ordinary high waters, by a facing of mortar 10 mm. (1/2 in.) thick, resting on a small concrete foundation, maintained by pegs and a light timber frame-work. Above this facing the banks are only turfed. The total length of the port on the river is 1,500 m. (1,640 yds.).

The port was gradually put into service as the works advanced and the tracks were laid. The latter included a crane-track, two service tracks and a shunting track connected with the station at Sucy-Bonneuil, on the Paris-Verneuil line.

Later on, as they were needed, tracks were laid for stocking goods which had to be kept on hand, such as coal, steel bars and blooms, railway material, etc.

A group of shunting lines composed of 13 tracks of 500 m. (547 yds.) available length was laid out near to the port for the making-up of trains and the reception of wagons.

The plant, which followed the development of the port, includes at the present time 21 three to five ton cranes, bought in England and America (Priesmann, Brown-Hoisting cranes).

There is also a store for corn and sundry stores and workshops.

Behind the port platform on the river, before the war, a large wet dock 70 m. (76.5 yds.) wide at the water-level was excavated, from which will branch off, later on, a series of lateral wet-docks each 60 m. (68.5 yds.) wide.

The central wet-dock was excavated on a length of about 500 m. (550 yds.) and the first lateral wet-dock, already commenced on its entire length, is 250 m. (275 yds.) long.

However, only the left bank of the central wet-dock was put into service during the war.

The Port of Bonneuil should be considerably enlarged. The central wet-dock ought to be prolonged and connected with the Seine towards Choisy-le-Roi so as to give the port a second entrance, from the Seine.

Three new wet-docks should be opened, of which two on the right side and one on the left of the central wet-dock.

The port thus laid out would comprise two essentially distinct parts: the port on the river which would continue to be used for transhipment operations and for stocks, and the inner port which

would be laid out as an industrial port with concessions of plots for the installation of industries utilizing the waterway.

With the construction of the Port of Bonneuil, we shall allude to that of four graving-slips for pinnaces, barges and tugs, which were also built during the war, at Charenton, close to the Port of Bonneuil.

These slips have the following dimensions respectively :

Length 51 m. 90 (170 ft.)	Width 12 m.00 (39.36 ft.)
51 m. 90 (170 ft.)	12 m. 00 (39.36 ft.)
60 m. 85 (200 ft.)	10 m. 50 (34.50 ft.)
54 m. 00 (177 ft.)	11 m. 60 (38 ft.)

Their situation, near to Paris, at the confluence of the Seine and the Marne, makes them capable of rendering important services for small craft.

They are worked in the name of the State by the « Office National de Navigation ».

The works were executed under the direction of Mr. Drogue, Ingénieur en chef du Service de la Navigation de la Seine (2nd Section), de la Marne et de l'Yonne.

The method employed for lengthening and widening the Créteil lock, without interrupting the navigation, deserves to be pointed out.

In a dry excavation, were constructed some reinforced concrete caissons destined to constitute the new lock-chamber for the up-stream gates of the lock, and the new downstream one. The closing of the two ends of each caisson was done by means of provisional water-tight wooden partitions.

The finished caissons were floated to the places that they must occupy against the masonry of the old lock-bays.

The excavation had been previously prepared by dredging and some piles had been driven in it, then exactly dressed to the height of the under side of the caissons to be immerged.

The caissons were then gently sunk on to the piles. Cement injections filled up the spaces which remained empty between the piles under the gate chambers, and the joining of the caissons

to the old masonry was obtained by running cement into the space which had been provided for this purpose.

As for the widening of the lock-chamber, this was done by levelling the side-wall of the right bank (land side). To this end, the masonry was perforated by three vertical holes per running metre of side-wall, and in these holes small charges of powder were exploded.

In order to utilize the former gates in spite of the increase in the width of the sluice heads, the deflection of the mitre was reduced.

Navigation was only interrupted during the time strictly necessary for the placing of the caissons.

We must also draw attention to the use of reinforced concrete in the construction of the Charenton graving-docks. For the shutting of the slips, more especially, sliding doors of reinforced concrete were adopted, which work in a very satisfactory manner.

The costs, entirely supported by the State, are as follows:

Construction of 4 graving-docks at Charenton ..... fr.	641,738.00
Deepening of the canal of the Marne, between Charenton and Bonneuil	1,415,561.66
Construction of the Port of Bonneuil	4,333,377.96
Lengthening and widening the Créteil lock..	419,747.10

The work on the Port of Bonneuil is not finished; the above figures correspond to the actual state of the work.

The importance of the services rendered by the Port of Bonneuil during the war stand out from the following table, which indicates the traffic since its opening :

Year 1917	497,593 tons
Year 1918	449,046 »
Year 1919	330,887 »

(From information supplied, in May, 1920, by Mr. Deval, *Ingénieur en chef des Ponts et Chaussées, Service de la Navigation de la Seine (2nd Section) de la Marne et de l'Yonne et Ponts de Paris, Pavillon de la Navigation, Port de la Bourdonnais, at Paris.)*

THE RHONE

Improvement and extension of the Port of Valence on the Rhone.

These works, decided on in 1911, stopped by the war and recommenced in 1919, include the construction of 330 m. (360 yds.) of quay, 4 m. 25 (13 ft. 95) above low-water mark with plant and warehouse (to begin : one 3-ton travelling electric crane and a covered warehouse 40 m. × 10 m. (131 ft. × 33 ft.).

The quay will be connected with the Drome railway section.

The estimates for the works of construction of the quays are 325,000 francs, of which 285,000 are borne by the State and 40,000 by the town of Valence.

The costs of plant and warehouse are borne by the « Société concessionnaire de l'outillage ».

It was calculated, when the project was presented in 1907, that the traffic, which was then about 20,000 tons, would increase, after the fitting up of the port, to 40,000 tons.

(From information supplied, in May, 1920, by Mr. Pascalon, *Ingénieur en chef des Ponts et Chaussées, Service spécial du Rhône, rue Grolée, 9, Lyons.)*

THE SEINE

Lengthening of the Port haut de Javel, on the Seine, at Paris, between the Grenelle and Mirabeau bridges, left bank.

The new port (see cross-section herewith) has been built on the site of a towing port, between the down-stream extremity of the old high port and the Mirabeau bridge.

It is joined by railway to Grenelle-Ceinture station and its special object was to improve and develop the Port of Javel for the needs of the war and notably the conditions of discharging goods for civil and military revictualling.

The new port has a length of 280 m. (305 yds.) and an average width of 25 m. (27.5 yds.).

By reason of the necessity for haste, the following dispositions were adopted, which allowed of using the materials that were on hand or that could be procured most easily.

The part on the river was formed by à wharf on reinforced concrete piles with a timber floor.

The piles came from works in hand at the moment of the declaration of war, the timber was supplied by the army.

The piles are arranged in two rows distant 3 m. (9 ft. 84) between centre-lines with intervals of 2 m. 80 (9 ft. 18) in each row.

The floor is composed of 1 ft. to 1 ft. 2 in. oak girders, supporting cross-pieces of 8 in.-1 ft., embedded, on the land side, in a concrete wall, on which are nailed the 3 1/4 in. planks. Over the planks a layer of concrete, covered with cement, serves as a foundation for the paving.

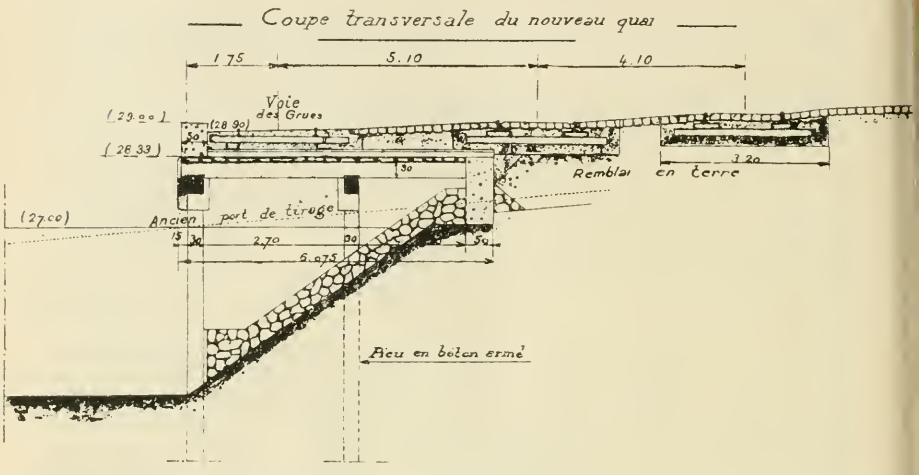
On the river side, the coping of the quay is formed by a small concrete wall.

Dredging operations executed after the driving of the piles allowed of obtaining a depth of 3 m. 20 (10 1 2 ft.) before the port

The tracks include the crane track, two service lines and a shunting line.

For the time being the plant consists of a 55 ton American Brown-Hoisting crane.

The estimates for the works were 598,000 francs of which 95,000 francs for the superstructure (making the port platform and paving).



Lengthening of the Port haut de Javel.

Coupe transversale du nouveau quai = Cross section of new quay. — Voie des grues = Track for cranes. — Ancien port de tirage = Old towing port. — Remblai en terre = Earth filling. — Pieu en béton armé = Reinforced-concrete pile.

The port can hold five boats. Its capacity for traffic is 1,000 tons per day.

The cost, entirely supported by the State, amounted to fr. 630,043.99 not including the tracks, thus exceeding by fr. 32,043.99 the expenses anticipated.

In this figure dredging enters for a sum of 154,000 francs.

The operations, undertaken for the needs of the army, did not produce any receipts.

The works were executed under the direction of Mr. Drogue, Ingénieur en chef du Service de la Navigation de la Seine (2nd Section).

They were commenced in November, 1914, and finished towards

the end of 1918, but the port was worked according as the work advanced.

(From information supplied in May, 1920, by Mr. Deval, *Ingénieur en chef des Ponts et Chaussées, Service de la Navigation de la Seine (2nd Section) de la Marne et de l'Yonne et Ponts de Paris, Pavillon de la Navigation, Port de la Bourdonnais, at Paris.)*

. . .

Construction of a port, on the Seine, at Ivry, on a length of 1,250 m. (1,367 yds.), between the Conflans bridge and the limit of the Paris Octroi.

At the present time there exists at Ivry, above the Conflans bridge, on the left bank of the Seine, a port 350 m. (383 yds.) in length, connected with the Paris-Orleans railway (Chevaleret station), which is principally used as a transhipping port.

Its equipment is composed of four railway tracks running the full length of the new port : a track for cranes, two service tracks and a shunting track.

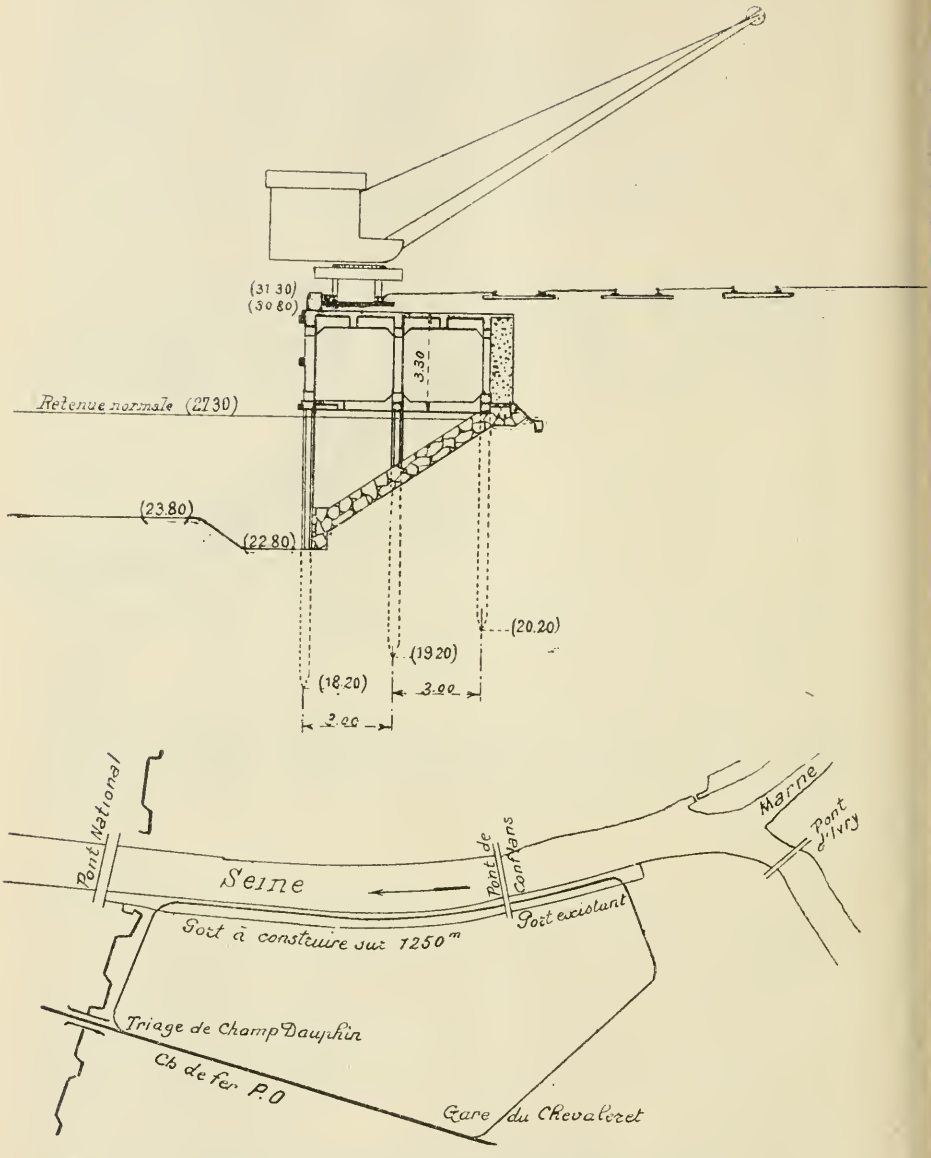
The equipment for which the concession has been applied for by the Paris Chamber of Commerce should include 4 five-ton cranes, 8 three-ton cranes, 874 yds. of warehouses and the necessary mechanical appliances for replacing the wagons on the service tracks.

This port, of which the traffic reached 350,000 tons in 1918 and 450,000 in 1919, has become absolutely inadequate.

The new port that is planned is a continuation of the preceding one, down-stream, and extends to the entrance to Paris.

It will be joined, up-stream, by the tracks of the existing port to Chevaleret station, and, down-stream, by a special line using the fortification lands, to the group of shunting sidings of the Champ Dauphin.

The new port will have, on the river side, a reinforced-concrete wharf, with a reinforced-concrete floor (see figure herewith), supporting a platform with a slight slope of 0 m. 03 joining it to the quay of Ivry. The wharf will be formed by three rows of 12 in. octogonal piles set 3 m. (9.84 ft.) apart. In each row the



Construction of a port on the Seine, at Ivry.

Pont National = National Bridge. — Port à construire sur 1,250 m. = Port to be constructed on a length of 1,367 yds. — Triage de Champ Dauphin = Champ Dauphin Shunting-Sidings. — Ch. de fer P.-O. = Paris-Orléans railway.

distance between the centres of the piles will be 2 m. 80 (9 ft. 2). A reinforced-concrete framework will rest on the piles with vertical uprights 10×10 inches, connected on the one side to the piles and on the other to the girders and parts of the floor by means of strong braces. The plaster floor will have a thickness of 3 1/2 inches.

On the land side, a blind-wall of cement connected with the wharf will support the embanking.

The slope of the bank will be protected by a layer of stones 2 ft. thick.

The bed of the river will be dredged to a depth of 3 m. 50 (11 ft. 48), but the length of the piles and the manner of protecting the bank will allow of this depth being increased to 4 m. 50 (14 ft. 76) without there being any necessity to modify the work.

The estimated cost of the under-structure alone is 3,890,000 francs. This will be supported in equal parts by the State, the Department of the Seine and the Paris Chamber of Commerce.

The expenses resulting from laying the tracks and the paving-stones on the part occupied by the tracks are calculated at 2,800,000 francs; they will be supported by the Paris Chamber of Commerce, who will be recompensed by levying a tax of fr. 0.20 per ton on all goods running over the branch line, either coming from or going to the Orleans system.

The handling appliances and the warehouses will be put up at the expense of the Paris Chamber of Commerce who has the concession for the equipment of the actual port and have applied for that of the equipment of the proposed port.

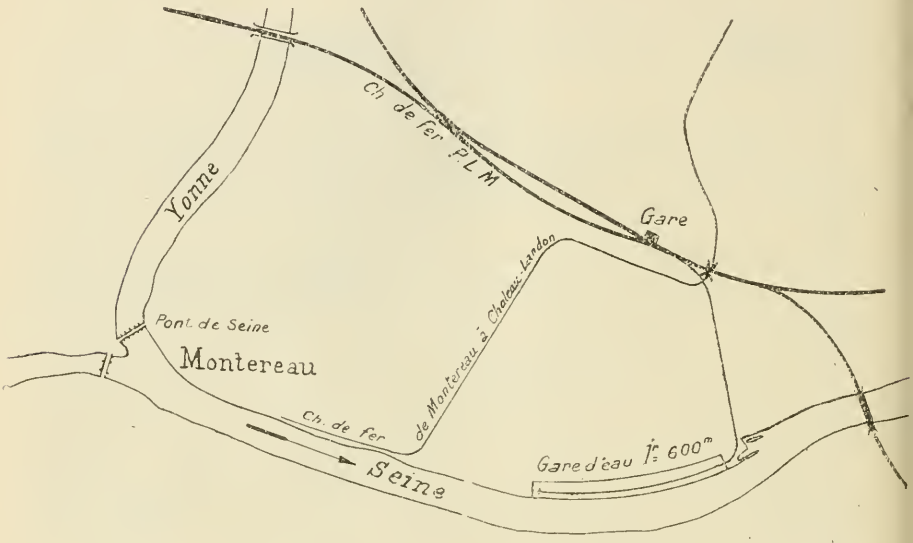
The railway lines will be worked by the Paris-Orleans Co. who already work those of the old port.

The new port will be able easily to cope with a transhipment traffic of 7 to 800,000 tons.

(From information supplied, in May, 1920, by Mr. Deval, *Ingénieur en chef des Ponts et Chaussées, Service de la Navigation de la Seine (2nd Section), de la Marne et de l'Yonne et Ponts de Paris, Pavillon de la Navigation, Port de la Bourdonnais, at Paris.)*

Water-side station at Montereau connected with the P.-L.-M. railway.

The new port of Montereau (see sketch herewith) has been laid out on the left bank of the Seine, about 550 yds. below the local station on the river-side of the local narrow-gauge railway from Montereau to Château-Landon.



Water-side station, at Montereau (France).

Ch. de fer = Railway. — Gare d'eau, long. 600 m. = Water-side station 656 yds. long.

Planned in the first place for the requirements of the war, this port is also destined to develop the mixed transports for the Seine-and-Marne and Aube departments. It will especially serve for the transhipment of coal going to the Aube department, replacing the port of Sens which is not so well situated and which had been provisionally extended during the war.

The port extends 600 m. (656 yds.) along the Seine. The platform was made at 49 m. 30 (194 ft. 5) above reference datum by means of banks formed of the dredgings from the river.

The bank was protected above water-level, by a concrete facing 0 m. 10 (4 in.) in thickness resting against a timber framework kept in place by stakes 8 ft. long placed 3 ft. 3 in. apart.

Flights of steps have been built in the bank at intervals of 55 yds.

The tracks include, one for cranes, two service lines and a through traffic line; this last goes to Montereau station.

Behind the tracks plots have been laid out for stocking goods.

The equipment is composed of two Brown-Hoisting cranes of 7 1/2 tons at 5 m. 80 (19 ft.) and 1,36 ton at 55 ft.

Warehouses will be put up later on by the grantee.

The port can receive 12 boats simultaneously.

The cost of the works is about 1,200,000 francs.

It is entirely supported by the State.

The traffic reckoned on is composed of: 40.000 tons of coal (merchandise which now goes to the Port of Sens); 10,000 tons of coal for manufacturers of the Montereau district; 30,000 tons of fire clay and China clay shipped by boat for Choisy-le-Roi, Paris and Rouen.

To begin with a minimum of 50,000 tons can be relied on.

According to the estimates the costs should have been 466,000 francs; in reality they were:

For the understructure, about	fr.	607,000.00
For the tracks		395.000.00
For making the roads		89,000.00
Total.....	fr.	1,091,000.00

to which must be added about 110,000 francs for land bought.

The original plan was for a port of only 350 m. (383 yds.). It was made 250 m. (273 yds.) longer with a view to the forwarding of macadam arranged for by the service of roads for the reconstitution of the regions liberated.

The works were executed under the direction of Mr. DROGUE, Ingénieur en chef du Service de la Navigation de la Seine (2nd Section). They were commenced in 1918 and finished in October, 1919.

(From information supplied, in May, 1920, by Mr. DEVAL, *Ingénieur en chef des Ponts et Chaussées, Service de la Navigation de la Seine (2nd Section), de la Marne et de l'Yonne et Ponts de Paris, Port de la Bourdonnais, Paris.)*

I. INLAND NAVIGATION

B. CANALS

LATERAL CANAL TO THE OISE, SAINT-QUENTIN CANAL AND THE CANALIZED SCHELDT

Installation of electric towing by tractors.

By a decision of the 15th of June, 1915, the Minister of Public Works approved a project for the installation of electric towing by tractors on the Canal lateral to the Oise, the Saint-Quentin Canal and the canalized Scheldt between Janville (Oise) and Etrun (Nord).

This project includes:

1° The laying, on the tow-path, of 140 kms. (87 1/2 miles) of metre gauge track, 18 kg. (39 lb. 6) Vignole rails, on sleepers and ballast;

2° The purchase of 150 tractors to be worked by continuous current at an average voltage of 550 volts and able to give in a continuous manner the total efforts indicated in the table given below for the corresponding speeds:

1,000 kgms. (2,200 lbs.) for 3 kms. (1 7/8 mile) per hour.
800 kgms. (1,760 lbs.) for 3.3 kms. (2 5/8 miles) per hour.
320 kgms. (704 lbs.) for 5 kms. (3 1/8 miles) per hour.
70 kgms. (154 lbs.) for 7 kms. (4 3/8 miles) per hour at least.

Each tractor, with two pairs of coupled wheels and weighing 8 tons with the possibility of increasing this weight to 9 or 10 tons by means of ballast for which a place is reserved, includes a series-motor, with fixed brushes, of a permanent force under continuous running of 12 actual horse-power measured at the rim of the wheel, a controller and a sliding contact with a flexible cable;

3° The establishment of two electric lines, one for carrying three-phase current at 15,000 volts, 50 periods, on cement posts, copper wire 20 mm², the other for the trolley fed by continuous current at 600 volts at the sub-stations, copper wire 87 mm², the earthing of the current being through the connected rails of the track;

4° The installation of 12 sub-stations, of which only one half will be built at first, at intervals of about 12 kms. (7 1/2 miles), each including two traction groups (of which one in reserve) of

200 normal kilowatts power, each group being formed of a three-phase transformer, type oil-bath and natural cooling, of 220 KVA —1,500V/370 V, with contacts at 1/3 of the voltage on the secondary for starting the rotary converter, and of a 200 kw. three-phase rotary converter, 50 periods, 1,500 revolutions per minute, 600 volts, 333 amperes, compound type with dampers, auxiliary poles, speed checking apparatus, reversing exciting switch and balancing switch for parallel running.

The current must be obtained from private concerns and the works executed either directly by the authorities or by tender.

Objects aimed at: The towing on the above-mentioned navigable way being done normally by trains of two loaded barges at a speed of 3 kms. (1 7/8 miles) per hour and of two empty ones at 5 kms. (3 1/8 miles) per hour, the objects aimed at, in substituting electric towing for animal are the following:

1° Increase by more than 100 p. c. of the average daily speed of the barges (15 5/8 miles instead of 7 1/2 miles by animal traction) and consequently notable improvement in the efficiency of the floating material;

2° Considerable reduction of labour, 1 wattman replacing 4 drivers;

3° Reduction in the cost of freight.

Principal dimensions:

A) *Tractors:* width 1 m. 80 (5.8 ft.) by 2 m. 80 (9.8 ft.) height above the rail.

Length between buffers: 3 m. 75 (12.3 ft.).

Wheel base : 1m. 80 (3.94 ft.).

B) *Buildings for use as sub-stations, depot, workshop, store and office:*

	Length.	Width.	Height under tie-beam.
Sub-station : 2 groups plus the eventual site of a 3rd. group .	11 m. 00 (36.1 ft.)	6 m. 50 (21.3 ft.)	7 m. (23 ft.)
Annex as sectional post . . .	3 m. 60 (11.8 ft.)	3 m. 00 (9.84 ft.)	9 m. (29.5 ft.)

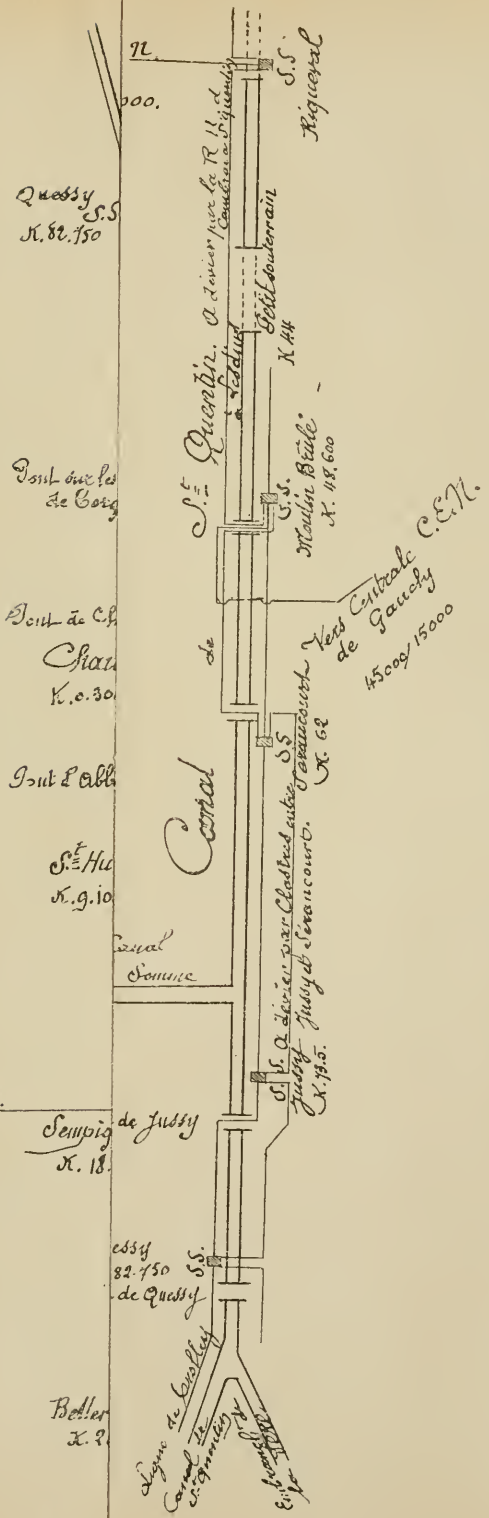


Diagram (France)

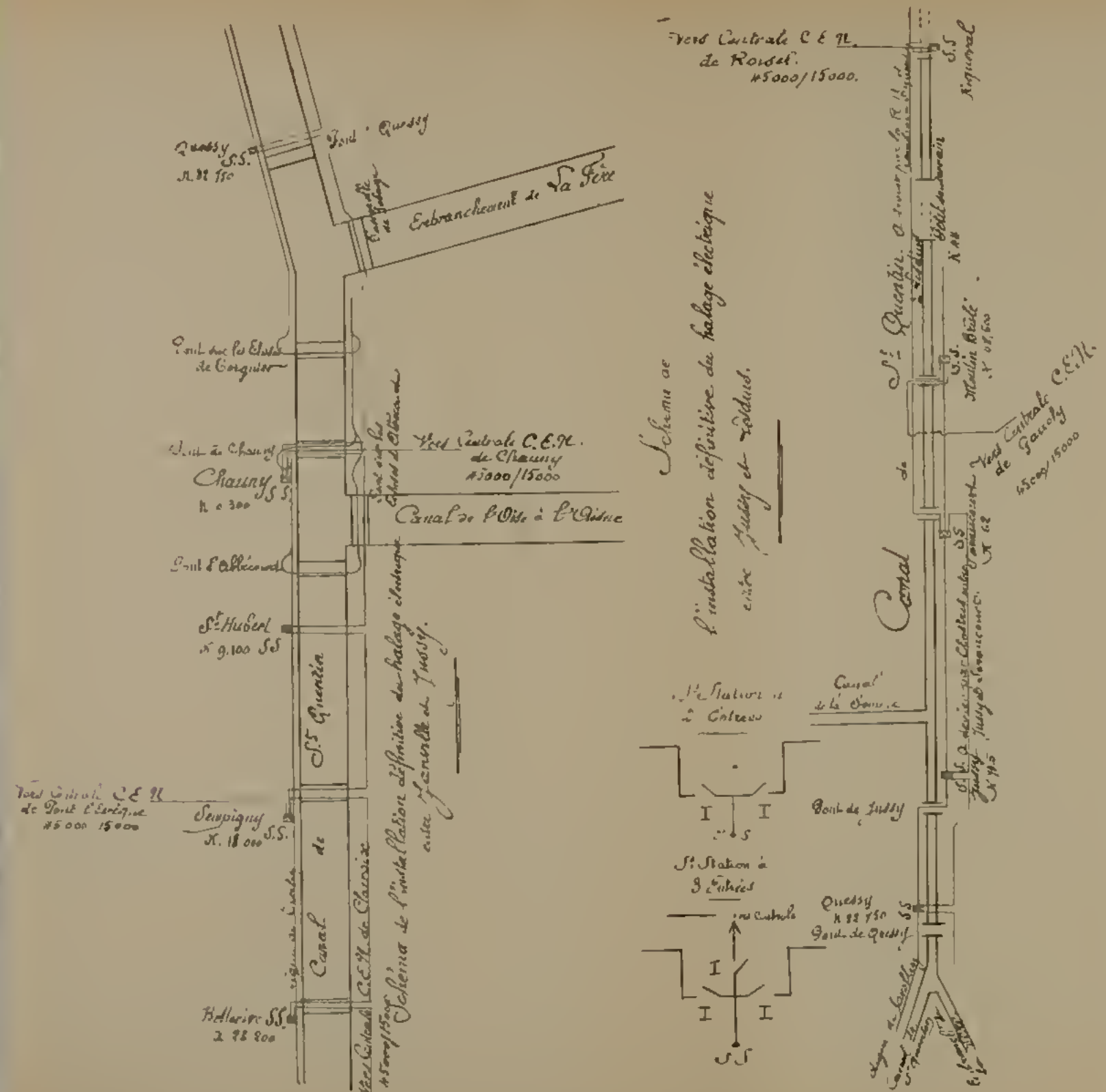


Schéma de l'installation définitive du halage électrique entre Quessy et Goldard.
Canal de St Quentin
Embranchement de La Fère
Canal de l'Oise à la Sambre
Canal de la Sambre
Quessy S.S. n° 22 150
Chauny S.S. n° 6 300
Ste Hubert n° 9.100 S.S
Seringny S.S. n° 18 000
Hallaire S.S. n° 28 800
Vers Centrale C.E.N. de Chauny 15000/15000
Vers Centrale C.E.N. de Pont l'Evêque 15000/15000
Vers Centrale C.E.N. de Rouet 15000/15000
Vers Centrale C.E.N. de Fauroly 15000/15000
Pont de Quessy
Pont de Chauny
Pont de Jussy
Pont de Seringny
Pont de Hallaire
1re Station à Cuves
2e Station à 3 Cuves
Quessy n° 22 150
Moulin Brûlé n° 17 600
Jussy n° 15
Seringny n° 18
Hallaire n° 28

Diagram of the electric installation laterally to the Oise — Saint-Quentin canal (France)

	Length.	Width.	Height under tie-beam.
Workshop with pit 4 m. × 2 m. 10 (13.12 ft. × 6.9 ft.)	7 m. 89 (25.89 ft.)	6 m. 14 (20.1 ft.)	4 m. 20 (13.8 ft.)
Tool store . . .	3 m. 96 (13.00 ft.)	3 m. 04 (9.97 ft.)	
Oil store	1 m. 96 (6.4 ft.)	1 m. 92 (6.3 ft.)	
Office	1 m. 96 (6.4 ft.)	1 m. 92 (6.3 ft.)	
Depot for 18 tractors with pit 12 m. 75 × 0 m. 85 (42 ft. × 2.8 ft.) .	24 m. (78.7 ft.)	9 m. 40 (30.8 ft.)	
Eventual lengthening of depot .	8 m. (26.2 ft.)	9 m. 40 (30.8 ft.)	

The estimate for the works amounts to 10,700,000 francs, including the traction track valued at 3,000,000 francs.

The cost is entirely supported by the State.

The annual receipts from the working are estimated at 3,192,000 francs and the expenses at 2,074,000 francs, thus an annual profit of more than a million; as far as the traffic is concerned, it should correspond with the maximum output of the double locks of the Saint-Quentin Canal, i. e. 8 barges per hour in each direction.

The works executed to date are:

1° The placing of 16 kms. (10 miles) of track between Janville and Pont-l'Evêque (Lateral canal to the Oise);

2° The erection of the trolley line and the placing of the electric connexions between the aforesaid points;

3° The construction of the Bellerive building as a sub-station, depot, workshop and store and the electrical equipment of this sub-station.

On the other hand, the following material has been supplied:

100 electric tractors;

ten 200 kw. groups, including switchboards and appliances;

50 kms. (80,450 yds.) of copper wire for H. T. and L. T. lines together with wooden and cement posts.

The works now being executed are :

1° The construction of the Sempigny, Saint-Hubert and Chauny buildings;

2° The erection of the trolley-line from Pont-l'Evêque to Chauny and the power line from Clairoix to Riqueval.

The Janville-Pont-l'Evêque section is not yet working, the power line not being finished. However thanks to a provisional central-station, it has been possible to make some traction trials of which the most conclusive results are briefly indicated hereafter.

A tractor supplied with current at an average voltage of 550 volts pulled a train of three loaded barges at a speed of 3 km. 2 (2 miles) per hour, a train of two loaded barges at a speed of 3 km. 6 (2 1/4 miles) per hour, one loaded barge at a speed of 4 km. 5 (2 4/5 miles) per hour; the speed of the same tractor unharressed was 5 miles an hour.

The works are being executed under the direction of Mr. NINCK, Ingénieur en chef du Service de la Navigation between Belgium and Paris, 35, rue de l'Oise, at Compiègne (Oise), by Mr. DURRINGER, Ingénieur des Ponts et Chaussées, 14, rue du Gouvernement, at Saint-Quentin (Aisne).

The expenses to date amount to about 3,500,000 francs.

Trials are now being made of a traction track embedded in the tow-path and laid on concrete sleepers; this type of track, besides costing less than the original type, has the great advantage of allowing motor-cars, vans, etc., to circulate on the bank.

The works were commenced in August, 1919.

(From information supplied, in August, 1920, by Mr. NINCK, *Ingénieur en chef des Ponts et Chaussées, chargé du Service de la Navigation entre la Belgique et Paris, 35, rue de l'Oise, at Compiègne (Oise).*

CANAL FROM THE MARNE TO THE RHINE

Installation of electric cable towing in and near the Foug tunnel.

The total length equipped is 5 kms. (3 1/8 miles) ; it is divided into 10 sections, of which :

one of 1,135 m. (1,241 yds.) includes the tunnel 875 m. (956 yds.) long and a cutting with single-track of 260 m. (284 yds.) ;

two sections with locks :

and the other sections at bridge crossings and in straight or curved reaches.

An electric capstan worked by a three-phase asynchronous motor of 20 HP. in the tunnel and 10 HP. in the other sections, sets an endless cable in movement, this is carried and guided by horizontal and vertical rollers, turning freely on fixed axles fixed to metal posts 1 m. 50 (4.9 ft.) high, bedded in the bank of the canal or in front of the berm in the tunnel. The movement of this cable is communicated to the barges through towing cables which are attached to the endless cable.

Three loaded barges are towed at a speed of 1 km. 700 (1.06 miles) an hour in the tunnel, of which the water section is only 15 m2 17 (163 1/4 sq. ft.) (Relation between this section and that of a barge drawing 1 m. 8 (5.9 ft.) is equal to 1.68).

In a free reach the boat is towed at a speed of 3 kms. 500 (2.2 miles) an hour.

The boring effect of the endless cables on the towrope has been done away with by the means of attaching the latter to the endless cable. The sheath of the tow rope does not turn with the traction cable.

The system was studied and executed by the « Compagnie Générale Electrique », of Nancy, who holds the patent rights by reason of a mutual arrangement.

The following are the costs of the different works :

Installation of electric cable towing	fr.	125,000.00

thus 25,000 francs per kilometre (5/8 mile), in 1915-1916.

Construction of posts for receiving and transforming the current, as well as the power-transmission lines along the canal..... 25,000.00

The costs were borne by the State.

The working is undertaken by the « Office National de la Navigation » in return for the towing dues.

The works were commenced in 1915 and finished in 1916.

(From information supplied, in June, 1920, by Mr. Imbeaux, *Ingénieur en chef des Ponts et Chaussées, rue Emile-Gallé, 16, at Nancy.)*

Bibliography : Two special pamphlets of the Compagnie Générale Electrique, Nancy, published in 1910 and 1914.

Note by Mr. Imbeaux (C. R. Académie des Sciences, 16th. February, 1914.)

La Nature, 11th. November, 1916.

* * *

Repair of the masonry-work of the Mauvages tunnel.

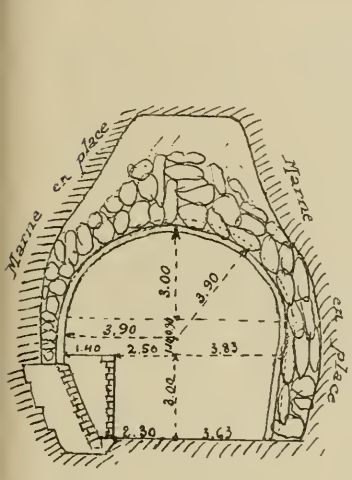
The construction of the Mauvages tunnel, 4 km. 877 (3,047 miles) goes back to 1841-1846. It is excavated in the compact clay of the geological kimmeridgian stratum. Clay presents great hardness at the moment of piercing; thus the old builders, deceived by its apparent rocky nature, were satisfied with a masonry facing of only 0 m. 30 (1 ft.). But under the influence of the air and the moisture, the rocks gradually surbed and distended. Disturbances were noticed in the towpath and in the opposite wall, then in the roof. Soundings allowed of establishing that important falls had occured on almost the whole length of the tunnel, behind the masonry-work, seriously threatening the solidity of the roof.

It was therefore decided to completely repair the masonry-work of the facing. The contract for this work was awarded to Messrs. Fougerolle Bros., after an adjudication, in 1910.

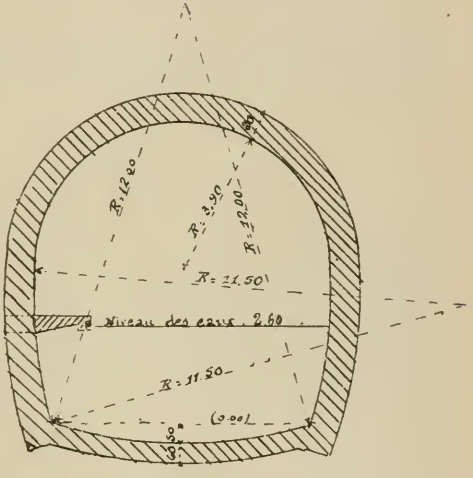
The new section of the tunnel (see figure below) includes a circular roof of 3 m. 90 (12.8 ft.) radius at the intrados, joined to two side-walls of circular form, with a radius of 11 m. 50 (37.73 ft.). The side-walls are joined at the bottom by an apron

in the shape of an inverted arc with a deflection of 0 m. 50 (1.64 ft.). The towpath is established on a bank of projecting reinforced concrete.

The work was carried out according to a method conceived by Messrs. Fougerolle and patented by them under the name of



Former section of tunnel



New section of tunnel.

« Method for carrying out, without the necessity of stoppages, sub-aqueous repairs on canals ».

The estimates for the works were before the war 9,600,000 francs and the costs entirely borne by the State. The works commenced in 1910 should have lasted seven years, but the war interrupted the progress.

In August, 1914, the costs already amounted to 6,073,212 francs.

The work was recommenced in 1918 as the result of two ministerial decisions dated the 12th November, 1918 and the 11th February 1919, under the following conditions:

1° Refunding by the State of all the expenses necessary for replacing the material and plants of Messrs. Fougerolle in the working condition in which they were at the time of the mobilisation, the settlement to be based on contradictory memoranda;

2° Payment of the works of reconstruction still to be done on the basis of market prices plus increases fixed each month accord-

ing to the prices of materials and labour and by comparison with pre-war prices.

The work since the war thus figures at about 12 millions, of which 2 millions were already spent in 1919. By reason of the state of the finances of the country, a credit of only 3 millions has been allowed for 1920, this has caused a slowing down of the work. It will be possible to finish the work in 1922 if the necessary financial effort is to be obtained.

(From information supplied, in June, 1920, by Mr. Imbeaux, *Ingénieur en chef des Ponts et Chaussées, rue Emile-Gallé, 16, Nancy.)*

Bibliography: Launay (F.). — Réfection des maçonneries du souterrain de Mauvages sur le canal de la Marne au Rhin. *Annales des Ponts et Chaussées*, 1912, 3, pp. 461-473, 1 pl.

Works connected with Ocean and inland Navigation, 1913. *Permanent International Association of Navigation Congresses*, p. 22.

CANAL FROM THE MARNE TO THE SAONE

Connection of the Canal at Heuiley-sur-Saône, with the railway line Grey-Auxonne, and plant for transhipment from wagons to barges.

The junction at Heuilly-sur-Saône was established for « The Military Roads Service » at the end of 1917 and beginning of 1918 with a view to the transport of road-mending material brought on wagons to the army zone.

The principal junction line, 879 m. (960 yds.) long, ends on an insubmersible tow-path where there is a shunting-line of 333 m. (364 yds.) ; four wooden stages at the bank permit the loading of two barges. They are provided with Decauville rails and turntables. Wagons discharge the materials into the boats by means of shoots.

The works were executed partly by the P.-L.-M. Railway Co. as far as the junction with the railway-line Grey-Auxonne (the part within the railway enclosure) is concerned. The deficiency amounted to fr. 34,108.52.

The other works including the transhipment plant and the junction line outside the limits of the P.-L.-M. Railway Co. were carried out by the « Canal from the Marne to the Saône » Administration, with the assistance of colonial workmen, and by means of supplies from the army. It has not been possible to estimate the cost of these works. The costs were deducted from the funds destined for military roads and the military working of navigable routes.

A ministerial letter of June 17th, 1919, decided upon the maintenance of the transhipment plant of Heuilly-sur-Saône and its opening for commercial service.

The working commenced July 19th, 1918. The transport of road-mending material ceased at the end of November 1918, by reason of the armistice.

Connecting line from transhipment port of Fort-Carré to Saint-Dizier with the station of the Est Co. of the same locality. Quay-wall along the port of Fort-Carré.

The line connecting the transhipment port of Fort-Carré to Saint-Dizier was established by the army during the winter of 1916-1917 for the needs of the military saw-mills installed at this port and supplied with round timber brought by water.

Working began from the 1st February, 1917.

Since the armistice the mills have been handed over to the « Liberated Districts Commission ».

The principal junction line has its origin on the flat-ground of the transhipment port which it serves for a length of 200 m. (218 yds.). Then it goes towards the goods-station of the Est Co., after another length of 300 m. (328 yds.) going over the property of the Domaine public fluvial and the high-road n° 7*bis* which it crosses on the level. A shunting line exists after crossing this road.

The quay-wall in cement-concrete of the Fort-Carré port, was constructed in 1919 by the « Service of Roads and Bridges ». It is 200 m. (218 yds.) in length and 2 m. 90 (9.5 ft.) in height including a coping of cut stone of 0 m. 40 (1.3 ft.).

The works of the junction were executed entirely by the army. By decision of August 8th, 1919, the Minister of Public Works approved the maintenance of the said junction which will be opened for commerce after the completion of the procedure decreed by the law of April 29th, 1919.

The quay-wall cost 290,000 francs.

The costs were taken from the funds of the « Military Working of Waterways ».

(According to information supplied in May, 1920, by Mr. Alex, *Ingénieur en chef des Ponts et Chaussées, 11, rue du Palais, Chaumont (Haute-Marne).*

MIDI CANAL AND LATERAL CANAL TO THE GARONNE

The works decided on in 1920 or previous to that year are the following:

A. — Deviation of the Gargailhan stream at the crossing of the Midi canal, near Béziers, (Department of l'Herault.)

B. — Weir at Beauregard on the Garonne, near Agen (Lot-et-Garonne).

1° Deep channel: Complete reconstruction of the channel;
2° Small channels: Raising of the piles and of the left bank abutment;
3° For the whole of the weir: Replacing of movable parts.

C. — Junction of the waterway, on the right bank of the port of Saint-Sauveur, at Toulouse, to the Midi railway line.

The works of deviation of the Gargailhan stream, not yet finished, are intended to deviate this stream into the river Orb. They were declared to be of public utility by decree of Dec. 17th, 1913, and are estimated at 760,000 francs.

The Gargailhan stream empties into the Midi canal, the waters of a stream which serves as the main sewer to a large part of the town of Beziers. The works foreseen are intended to turn aside these waters which contaminate two important reaches, by sending them into the river Orb, by means of a deviation with syphon crossing under the bed of the canal.

The syphon will be composed of two steel pipes 0 m. 80 (2.60 ft.) in diameter.

The expenses will be borne by the State, except a sum of 50,000 francs, which sum must be paid into the Treasury by the town of Béziers as its participation.

The weir of Beauregard, placed at the head of the Agen water-source, plays an important part in the water-supply, below Agen, of the lateral canal to the Garonne.

The works *carried out* consist of the complete restoration of the bed of the deep channel, 38 m. (41.8 yds.) wide, of the abutment and of the pier limiting this channel.

The works *to be executed* provide for: 1° The raising of the piles and of the abutment of the small channels by 0 m. 50 (1.64 ft.); works begun but suspended owing to the war; 2° The placing of fresh trestles for all the channels.

These various works will have the effect of raising by 0 m. 50 (1.64 ft.), the height of the actual water-level and will consequently permit of increasing considerably the volume of water in reserve below Agen.

The estimates were as follows:

1° Reconstruction of the deep channel (finished) ..... fr.	207,000.00
2° Replacing of the trestles of the deep channel	80,000.00
3° Raising the piles and the abutment of the small channels	29,000.00
4° Replacing trestles of the small channels....	24,000.00
Total.....fr.	340,000.00

The works of reconstruction of the deep channel of the *Beauregard weir* were executed partly by contract and partly by the State owing to the death of the contractor.

Cost of works carried out by the contractor fr.	207,309.80
Cost of works carried out by the State.....	43,890.97
Remittance of material and stores after decease	6,613.27
Settlement of account on the completion of the works	17,990.38
Total.....fr.	275,804.42
The amount of these expenses (pre-war estimates) including the guarantee was	207,000.00

* * *

In 1918 and 1919 a connecting line was constructed the length of the quay on the right bank of the port of Saint-Sauveur, at Toulouse, consisting of four lines of 1 m. 50 (4.9 ft.) parallel to

the bank of the quay-wall each being about 140 m. (153 yds.) long.

Planned during the war, the junction in question was intended to link up directly the Midi canal with the Toulouse powder factory, material arriving by water was not obliged to cross the station of Toulouse in all its length. The conclusion of hostilities greatly diminished its utility.

These junction works, estimated at 350,000 francs, were carried out by the Midi Co., to whom the State has reimbursed, up to the present, the sum of 307,479 francs.

(From information supplied, in July, 1920, by Mr. N..., *Ingénieur en chef des Canaux du Midi et Latéral à la Garonne, 10, Port Saint-Etienne, at Toulouse (Haute-Garonne).*

CANAL FROM MONTBELIARD TO THE HAUTE-SAONE

The construction of this navigable waterway was declared to be of public utility by the law of April 8th, 1879.

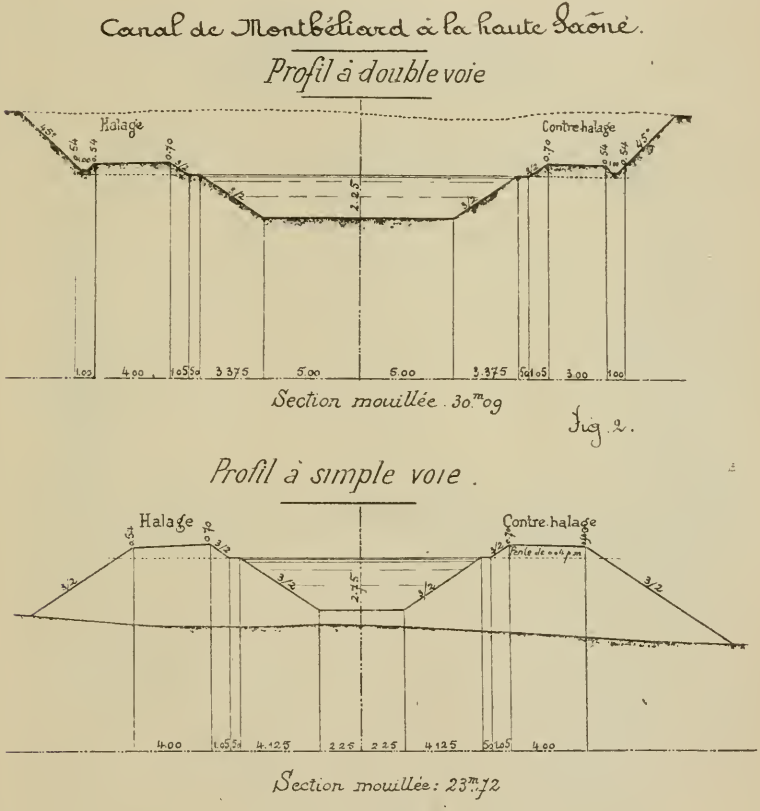
The canal, of a total length of 83 kilometres (52 miles), is constructed on a length of 11 kilometres (6 7/8 miles), in the Department of the Haute-Saône (water-shed reach and first reach towards the Rhone to the Rhine) and is under construction in the territory of Belfort and the Department of Doubs on a length of 18 kilometres (11 1/4 miles). (Fig. 1.)

FIG. 1

Schema des voies navigables de l'Est = Plan of navigable waterways of the East.

The object of this scheme is to connect the canal from the Rhone to the Rhine to the navigable Haute-Saône.

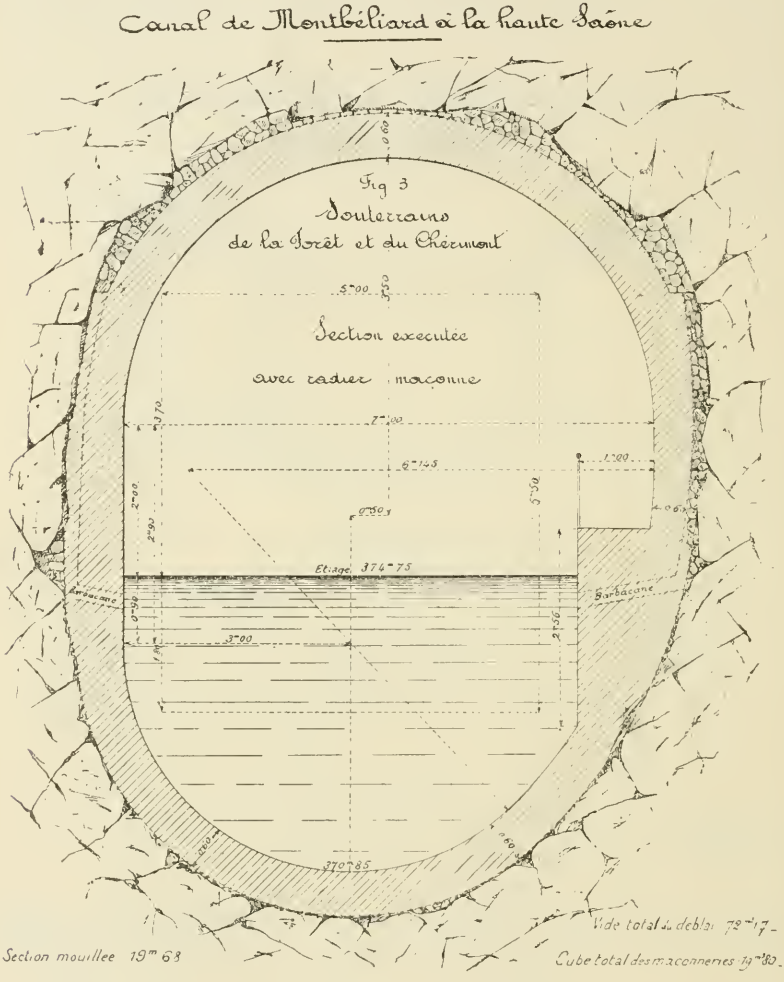
At the present time they are finishing the works under construction in the Haute-Saône, the territory of Belfort and the Doubs in order to be able to use the canal between the Rhone to



Profil à double voie = Double way section. — Profil à simple voie = Single way section. — Halage = Towpath. — Section mouillée = Water section.

the Rhine and Ronchamp and thus to serve the town of Belfort. The termination of the part included between the Rhone to the Rhine and the railway line from Besançon to Belfort is being pushed rapidly forward in such a way as to be able to fill it during 1921, the water being supplied by means of water-catchments in the rivers Douce and Savoureuse.

The part constructed or under construction is between the canal from the Rhone to the Rhine and the west end of the watershed reach at 4 kilometres (2 1 2 miles) from Ronchamp. The



Canal from Montbeliard to the Haute-Saône.

Souterrains = Tunnels. — Section exécutée avec radier maçonné = Section made with masonry bed.

lay-out of the Western part, not commenced, is still under consideration; however, a ministerial decision of October 29th, 1919, has decided to adopt the lay out of the canal through the valley of la Lanterne, which ends at the Saône, at Conflandry.

A branch to serve the factories of Belfort is being worked out. The normal sections of the canal are indicated in fig. 2.

1° *Works carried out*

The part of the canal at present constructed, except completion of works for prevention of leakage, which will be necessary before filling the canal, includes:

a) The water-shed reach;
b) The reservoir wall of the Ban;
c) The feed-water trench of the canal;
d) The trench for filling the Ban reservoir.

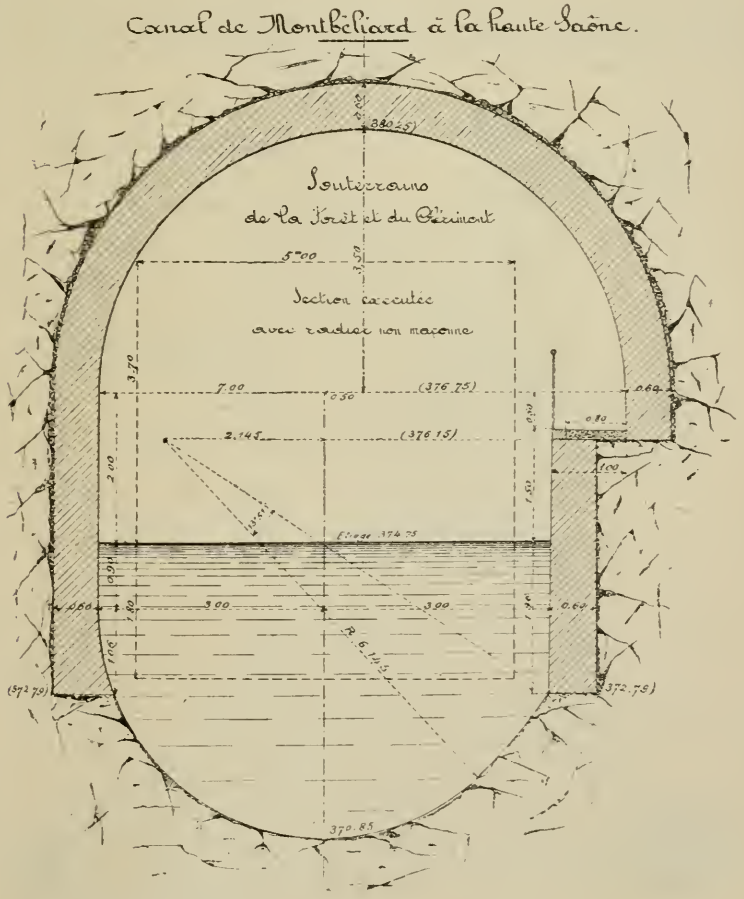


Fig 4

Section exécutée avec radier non maçonné = Section made without masonry bed.

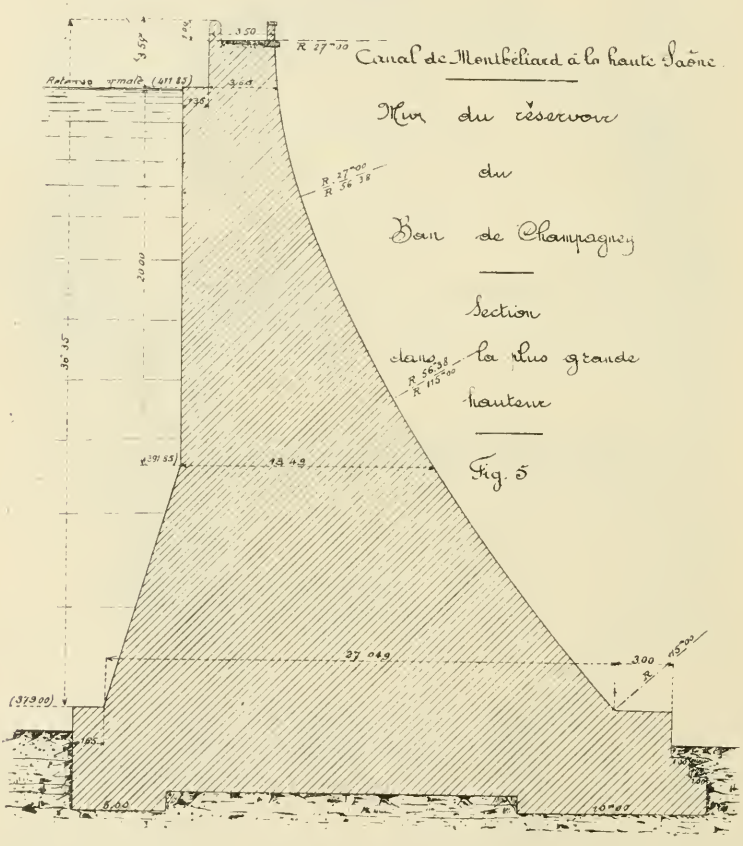
a) *Watershed reach*

This reach 10 kilometers 916 m. 70 (6 m. 1,450 yds.) long includes two tunnels, that of Forêt 650 m. (717 yds.) in length and that of Chérimont 1,330 m. (1,455 yds.) in length. The sections of these tunnels are shown in figs. 3 and 4.

b) *Ban de Champagney reservoir wall*

This reservoir, containing 13 million cub. meters (17 million cub. yds.), is destined to supply water to the canal.

The retaining dam, 800 m. (874 yds.) long is constructed entirely of masonry (about 260,000 yds3); the highest section 36 m. (118 ft.) is shown in fig. 5.



c) *Feed-water trench of the canal*

This trench 2 kilometres 500 (1.56 miles) long, is constructed with a gradient of one millimetre per metre, 1/1000, and the width of the bed is 1 m. 70 (5.5 ft.); the height of the banks permits of a flow of 13.3 yds. per second if the necessity arises.

Fig. 6 gives the section of this trench.

The works indicated above as a, b et c were terminated in 1907.

d) *Feed water trench for the Ban reservoir*

This trench, of a length of 2 kms. 800 (1 3/4 miles), was finished in the course of the year 1913; it will conduct the water of the river Rahin into the Ban reservoir.

It is built with an incline of 1 : 1000 and the bed is 6 m. 80

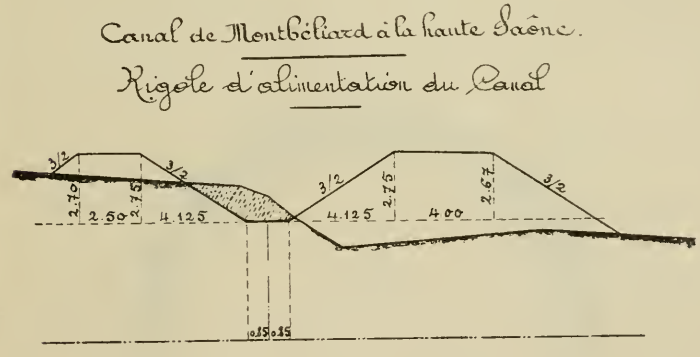


Fig. 6

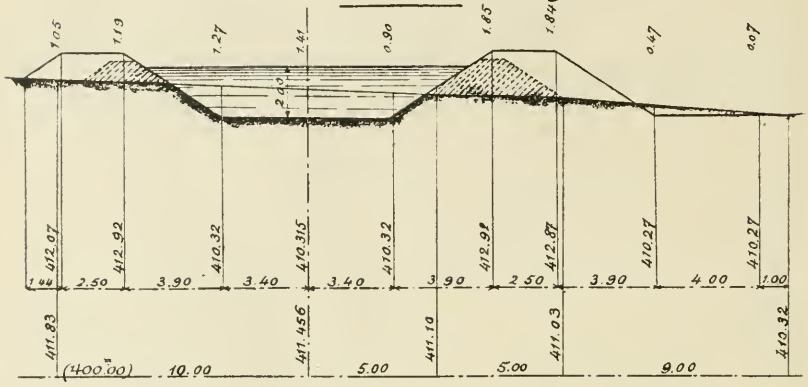
(22.3 ft.) wide; the height of the banks also allows of a flow of 13 yds3 per second.

It flows into the reservoir by a tunnel 165 m. (180 yds.) long; the normal section of the feed-water trench and the section of the tunnel are indicated in figs. 7 and 7A.

The lock at the Eastern end of the water shed (fall 3 m. 25) (10.66 ft.) is constructed, as is that of the first reach farther down, with the same fall. The lock at the Western end of the water-shed is also finished (fall 4 m.) (13.12 ft.).

Canal de Montbéliard à la haute Saône.

Section normale de la rigole



Rigole de remplissage du Réservoir du Bas de Champagney

Fig. E

Coupe en travers du Souterrain.

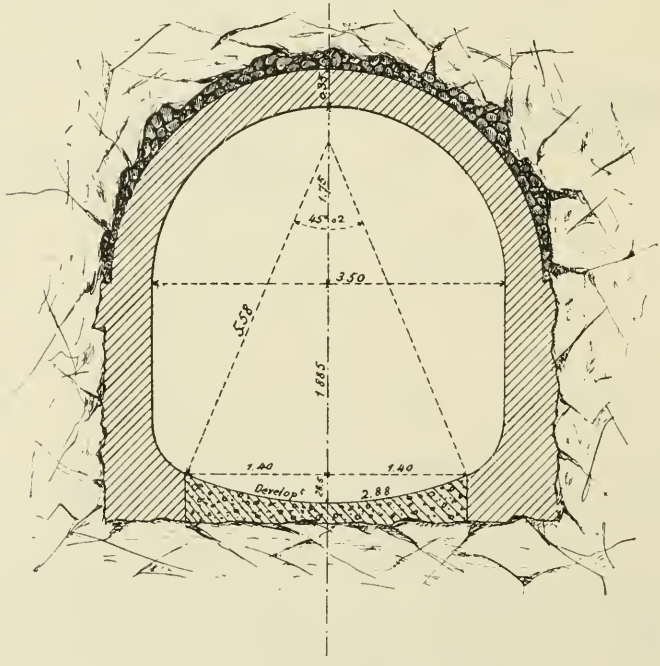


FIG. 7A

Section normale de la rigole = Normal section of trench. — Rigole de remplissage = Feed-water trench. — Coupe en travers du souterrain = Cross-section of tunnel.

2° *Works under way*

There are at present under construction :

1° The part of the canal comprised between the 2nd lock of the Eastern water-shed and the canal from the Rhone to the Rhine, on a length of 17 kms. 850 (11 1/8 miles).

There are in this part of the canal 6 locks with a fall of 3 m. (9.84 ft.) and 6 locks with a fall of 4 m. 25 (13.8 ft.).

The length of the basins is 38 m. 50 (42 yds.) and the width 5 m. 20 (17 ft.), as for the three locks already constructed at the ends of the water-shed reach.

The Allan and Savoureuse rivers are crossed by two metallic canal-bridges 40 m. (43.7 yds.) in length, the inlets of which have a water-section of 6 m. 40 (21 ft.) in width and 2 m. 25 (7.38 ft.) in height; each of these bridges is supported in the centre by a pillar.

2° A cement-concrete screen against the upper facing of the wall of the Ban reservoir, in order to prevent pressures from below on the masonry-work of the dam. The plans adopted have for object the realization of the following conditions :

a) To avoid all pressures on the lower base of the foundations ; this result will be obtained by drilling sounding-holes to a sufficient depth, so that the weight of the rocks is equivalent to the column of water at highest water-level ;

b) To leave above water the largest surface possible of the upper facing of the dam : the vertical pits and horizontal drains permit the realization of this project ;

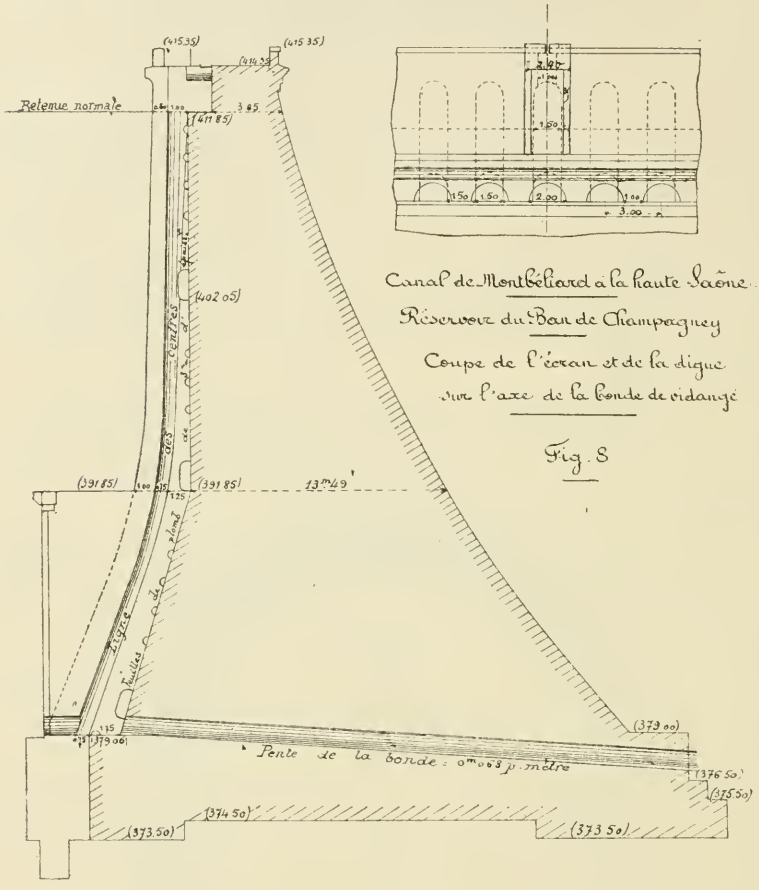
c) To maintain a certain connection between the old and new masonry ; this is obtained by the form of the dam and by cramp-irons joining the screen to the dam ;

d) To prevent absolutely the water from penetrating into the old brickwork at the right of the supporting right-angle, against this infiltration the use of lead sheets under the right-angles will be more efficacious than the layers of cement whatever be the composition ;

e) To prevent the consequences of the dilations and contractions of the masonry due to variations of temperature. Vertical joints 2 inches in width, placed at 50 m. (55 yds.) intervals on an average, will be constructed in the thickness of the structure, and

their filling will be obtained by a process employed for the reservoir of Bouillouse (E.-Pyrenees).

The screen is constructed of lime cement-concrete, with pits and inspection galleries to main drain. The vertical pits lying


Canal de Montbéliard à la Haute Saône
Réservoir du Bout de Champagney
Coupe de l'écran et de la digue
sur l'axe de la bonde de vidange
Fig. 8
Relevue normale
Pente de la bonde : 0m008 p. mètre

Coupe de l'écran et de la digue sur l'axe de la bonde de vidange = Section of screen and dam at emptying sluice.

on the upper facing of the dam, are at intervals of 3 m. (9.8 ft.) from centre to centre; they have at the top the form of a half-circle, 2 m. (6.56 ft.) in diameter. This form is then modified so as to end at a section formed of a half-circle of 1 m. 50 (4.9 ft.) in diameter, adjusted to a rectangle of 1 m. 50 at the bottom, and 1 m. 75 (5.7 ft.) in height at the lowest point of the dam.

Three horizontal inspection galleries 1 m. 60 (5.2 ft.) in height will be constructed against the facing of the dam, the lower one following the whole length of the bank; the middle one, 20 m. (65.6 ft.) below water-level, will be 120 m. (131 yds.) long and the upper gallery placed 9 m. (29.5 ft.) below this same level will be 294 m. (322 yds.) long. Semi-cylindrical openings 0 m. 50 (1.6 ft.) in diameter will be constructed in the thick part of the uprights and lead sheets 1/8 in. in thickness, will separate the dam from the screen between the semi-cylindrical openings. A semi-circular collector 0 m. 60 (1.96 ft.) in diameter placed at the level of the base of the foundations will receive and conduct to the emptying sluice the waters which may have crossed the screen-wall.

The principal features of the screen are indicated in figure 8.

The cost foreseen, by the law of April 8th, 1879, for the construction of the Montbeliard Canal to the Haute-Saône, following the trace of the Lanterne valley, is 22,000,000 francs.

This estimate was considered in 1913 only half-sufficient and it was reckoned that the costs would come to a total sum of 45,000,000 francs.

Under the present economic conditions, the total costs will certainly be tripled on the estimates of 1913.

The expense is entirely borne by the State, except for the branch canal to the Belfort factories, for which the participation of the Belfort Chamber of Commerce and the factories is counted on.

No toll dues are anticipated for navigation on the canal from Montbeliard to the Haute-Saône.

(From information supplied, in October, 1920, by Mr. MARGUERY, *Ingénieur en chef des Ponts et Chaussées, 16, rue de la Colombine, à Vesoul (Haute-Saône).*

THE NORD CANAL

The definite lay-out of the Nord Canal (see plan annexed) was approved by a ministerial decision of January 23rd, 1906.

The works begun in 1907 were suspended owing to the war, and have undergone considerable damage.

Various repairs are being done.

The work of finishing the Nord Canal must be taken up as soon as possible and will follow the general lines of the preliminary scheme which was declared to be of public utility by the law of December 22nd, 1903.

It is only possible to give temporary information about the plans which will be definitely executed.

At present, a project of the works to be undertaken is being prepared to make the Nord Canal accessible to barges of 600 tons, of 7 m. 50 (22.6 ft.) outside width, with a draught of 2 m. (6.56 ft.).

Water-supply. — The water-supply is the object of definite studies in the hypothesis of traffic corresponding to 30 alternate lockings every 24 hours (16,000,000 tons a year). Also the possibility of assuring the water-supply in the hypothesis of double this traffic will be examined (this would entail the doubling of the locks).

Cross-sections (see sketch). — The width of the canal has been fixed at 17 m. (35.8 ft.) with 2 m. (6.56 ft.) of water. The depth of the channel will be 2 m. 50 (7.2 ft.). The sections of the tunnels are maintained temporarily, except the widening of the channel by abolishing the tow banks, this is being done.

Structures. — Each double lock of 300 tons must be duplicated by a lock of 600 tons offering a width of 8 m. 50 (27.9 ft.), and an available length of 66 m. (72 yds.).

The overhead bridges will be set up with an opening which will average 39 m. (129 ft.), this opening will correspond to the normal width of the canal and the two towpaths five metres (16.4 ft.) in width constructed at 1 m. 50 (4.9 ft.) above the normal level of the water.

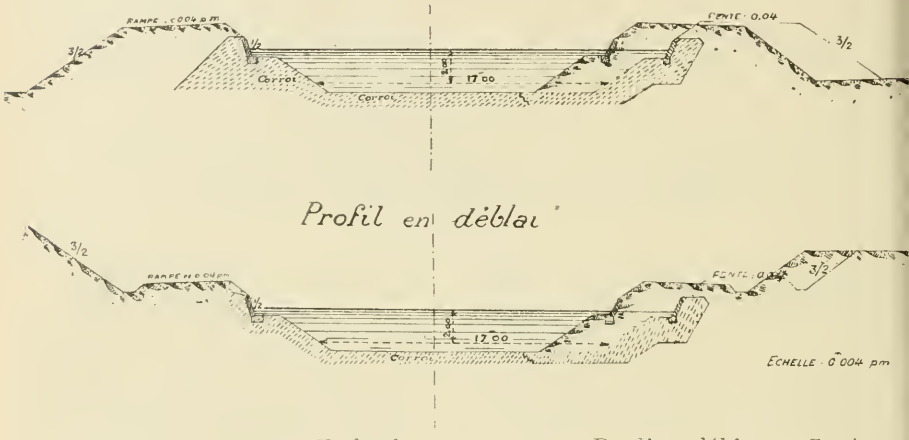
Canal du Nord

The cost of the whole of the work executed before the war amounts to about 73,000,000 francs.

The cost for the completion of the canal for boats of 600 tons will be about 80,000,000 francs at pre-war prices, that is at present prices, about 300,000,000 francs.

Besides the contributions for war damages, and a slight contribution from certain persons interested, the necessary funds

Profil en remblai .



Profil en déblai .

Profil en remblai = Embankment section. — Profil en déblai = Cutting section.

will have to be ralized by means which have been proposed to the higher Administration.

(From information supplied, in June, 1920, by Mr. Le Rond, *Ingénieur en chef des Ponts et Chaussées, 7, rue de Naples, Paris.)*

Bibliography: Works connected with Ocean and Inland Navigation, 1913, p. 31.

CANAL FROM THE RHONE TO THE RHINE

The works under construction on this navigable route (1) include the general improvement of the canal.

1° Between Besançon and Montreux-Château;
2° Between Besançon and the Saône.

They include notably:

Taking out rock;
Dredging, in the river and by-pass;
A by-pass 2 kilometres (1 1/4 mile) in length;
The lengthening of 35 locks;
The lowering of the sills and beds of 25 locks;
The construction of a safety lock;
Abolishing of one lock;
The construction of 70 metallic swing lock gates;
The lengthening and construction of weirs;
The revetment at several places of the canal bed;
The construction and raising of bridges and foot-bridges;
The lengthening of aqueducts, the construction of bridges as well;
The construction of retaining walls;
Some slopes.

These improvement works have for their chief object to place the navigable route in conformity with the gauge fixed by the ministerial circular of July 19th, 1880, that is to permit the passage of canal boats 38 m. 50 (124.64 ft.) in length on the whole length of the canal, from the Rhone to the Rhine, with a load of 300 tons.

Based on the programme of 1919, the costs were estimated to be about 30,000,000 francs, but this estimate will be certainly exceeded by an important sum.

The costs are entirely borne by the State.

Persons interested in this undertaking do not contribute.

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(1) See Works connected with Ocean and Inland Navigation, 1913, p. 46.

At the present moment, when the water is low, barges can only reach Besançon with a draught of 1 m. 60 (5.24 ft.) corresponding to a tonnage of 250 tons. The improvement will permit of a draught of 1 m. 80 (5.9 ft.), that is a tonnage of 300 tons. What is more, the improvement of certain difficult passes will have the effect of intensifying the traffic, without however it being possible to supply exact figures on this subject.

None of the works mentioned above has been finished in the course of the year 1919.

These works are however pretty well advanced and the filling of the canal may be hoped for towards the end of 1920.

However, the river dredgings are put off till 1921. Their cost is estimated at about 10,000,000 francs, so that barges can only circulate with a reduced tonnage, of about 250 tons, until the complete execution of the said dredgings.

The cost of the works carried out to the 31st December, 1919, amounts to 27,951,936 francs.

(From information supplied, in June, 1920, by Mr. Blaise, *Ingénieur en chef des Ponts et Chaussées, 7, rue Pasteur, Besançon.)*

CANAL FROM ROANNE TO DIGOIN

Building of a new dock (Oudan port).

The Canal from Roanne to Digoin takes its origin, at Roanne, from a fluvial basin, forming the first reach of the canal 830 m. (929 yds.) in length and 80 m. (87 yds.) in width. This dock is bordered by quay walls and railroads connected with the P.-L.-M. network (lines from Roanne to Saint-Etienne, to Lyons, to Paray-le-Monial, to Montchanin).

The port, thus formed, being insufficient, the building of a new dock has been undertaken, this latter is situated on the left bank of the canal, at 1,200 m. (1,310 yds.) downstream, from the present port and known by the name of Oudan dock or port, from the name of the stream in the valley of which the dock has been excavated.

The works were declared of public utility, by decree of the 9th of March, 1917.

The new port will be connected to the P.-L.-M. lines, on the one hand, with the line from Roanne to Saint-Germain-des-Fossés, by turning to account the junction fixed up for the service of the Arsenal de Roanne and, on the other hand, with the junction connecting the ancient port of Roanne with the lines from Saint-Etienne, Lyon, Paray-le-Monial and Montchanin.

A junction by railroad, is also being considered with lines of local interest of the department of the Loire.

The works are completed, except the junctions by railroad and some finishing touches. The dock will soon be open for navigation.

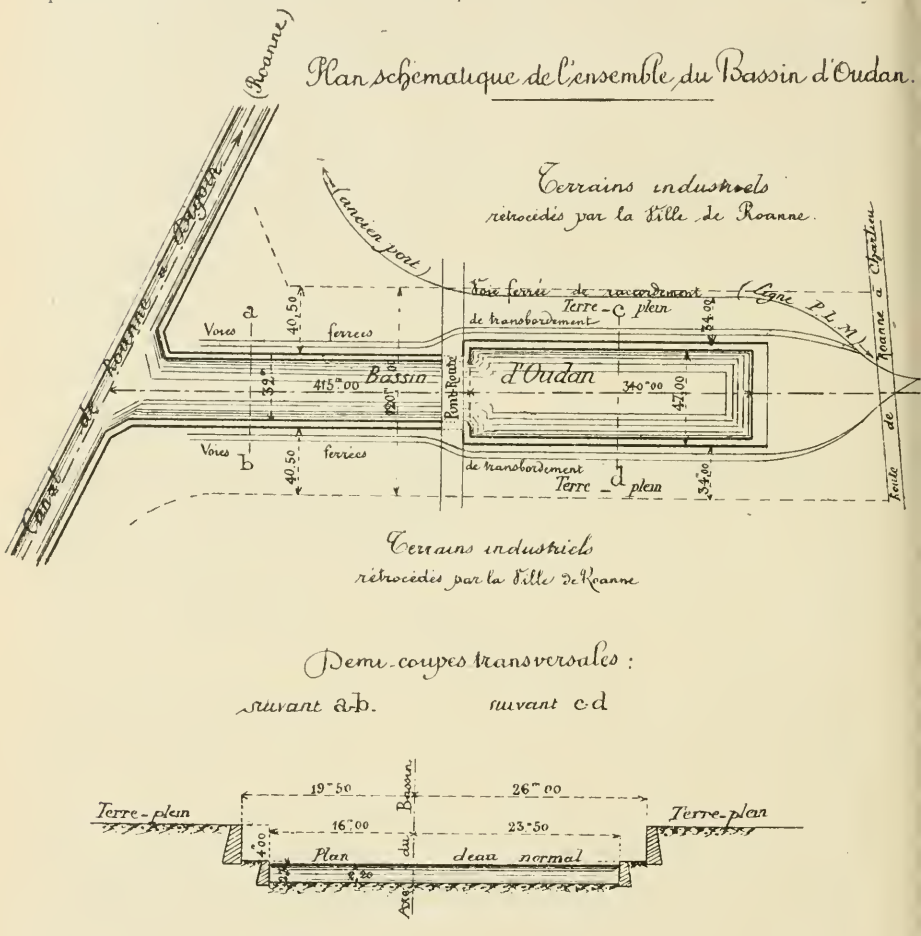
The Oudan dock is especially established in view of its utility for new trades, which have a tendency, owing to the war of 1914-1918, to spring up and locate themselves in the Roanne region.

The length of the dock is 755 m. (825 yds.). Starting from the junction with the canal from Roanne to Digoin, a first part of 415 m. (455 yds.) shows a width of 32 m. (35 yds.) between the quay walls; this width is increased to 47 m. (51 yds.) on the rest of the length.

The draught is 2 m. 20 (7.25 ft.) equal to that of the canal from Roanne to Digoin, with which the dock is in direct commu-

nication. At the junction of the dock and canal, a sufficient widening allows boats to turn.

Towpaths are to be found on each bank of the dock. On each bank also, there are platforms of 34 m. (37 yds.) and 40 m. 50 (45 yds.) in width intended for railway tracks, transhipment plant and warehouses. These platforms are levelled uniformly



General plan of the Oudan Dock.

Terrains industriels rétrocédés par la ville de Roanne = Building sites ceded by the town of Roanne.—Voie ferrée de raccordement (ligne P.-L.-M.) = Junction line to the Paris-Lyons-Mediterranean Railway.— Terre-plein = Platform. — Voies ferrées de transbordement = Transhipment lines.

Demi-coupes transversales = Half cross sections. — Suivant a-b = On a-b. — Suivant c-d = On c-d. — Plan d'eau normal = Normal water-level.

at 4 m. 50 (5 ft.) above the dock's waterlevel, and a supporting wall compensates for this height (see sketch here-below).

According to the original estimates, the works would cost:

a) Excavation of dock, arranging of ground, including purchase of same, junction tracks to the P.-L.-M. lines..... ...Fr.	910,000.00
b) Quay walls and breast walls	1,022,000.00
Total .....Fr.	1,932,000.00

As a matter of fact the expenses will amount approximatively to the figures here below:

a) Excavation of dock and arranging of ground	850,000.00
b) Works of art, others than the quay and breast walls	200,000.00
c) Junction to the P.-L.-M. lines.....	600,000.00
d) Quay and breast walls	1,250,000.00
Total expense .....Fr.	2,000,000.00

In principle, the quay and breast walls ought to have been built at the expense of traders taking advantage of this dock; but the town of Roanne has had the wall built, reserving the right of recovering this outlay by increasing the price of land conveyed to traders. All other expenses are to be divided between the State and the Town. This latter may be able to redeem its expenses by the working of the transhipping plant and by letting the ground of the new port, of which the yearly traffic seems capable of attaining 500,000 tons, pretty rapidly.

(From information supplied, in May 1920, by Mr. HUET, *Ingénieur en chef des Ponts et Chaussées, Nevers (Nièvre).*

REPAIRING OF NAVIGABLE WATERWAYS

damaged by warfare (Canal de l'Est, North branch; Canal des Ardennes; Canal de l'Aisne à la Marne).

In the zone of military operations and in the regions crossed by the retreating enemy, the locks have been quite disabled, either by the destruction of the two heads, or by the destruction of one head only downstream or upstream, or simply by the destruction of the gates. The bridges have been destroyed also as well as sundry works in the basin.

Certain parts of the canal were so damaged, that it was quite impossible to find any trace, in these places, of a waterway. Rebuilding had to be rapidly undertaken and particularly expeditions means had to be employed; they are described in a summary way, here below:

Locks. — Reconstruction in concrete, copings, angles of reversed walls, mitres, in ferro-concrete. Iron bracing of apron by means of I girders.

Intensive use of concreters.

Replacing lock-gates by entirely wooden gates. Replacing of working apparatus of the gates by racks, fixed up on trivets.

Weirs. — Filling-in of excavations occasioned by the swelling of the waters. Use of rock filling and of gabions of metallic wiring filled with stone detritus.

Basin. — Clearing of the navigable channel, obstructed by barges filled with stones and sunk by the Germans. Creation of channels by means of explosives fixed up on diving apparatuses. Filling up by means of concrete slabs of the numerous shell holes in the concrete casing of the channel of the canal from the Aisne to the Marne.

Bridges on downstream heads of locks. — Concrete abutments. Apron fixed up by iron girders separated by 0 m. 25 (9.84 ins.). Bricks laid flat fill up the air-gap. Concrete is poured in loose and forms a slab embedding the greater part of the girders.

Copes of works. — The deteriorated copes of works have been replaced. An ungalvanised metallic wiring has been placed, in a regular way, in the middle of the thickness of the copes to prevent their cracking.

Dams. — Repairing of cracked dams, by means of clayed stone, detritus, and by the help of concrete casing.

Navigation, impossible in 1918, on the canal de l'Est (Northern branch), was resumed on all its length in Sept., 1919, with a draught of 1 m. 70 (5.5 ft.).

It will be re-established at the end of 1920 on all the length of the Ardennes canal and on the canal from the Aisne to the Marne.

Owing to the extreme obstruction of the basin and of the channel, in certain parts of navigable reaches, explosives have had to be used and sometimes metallic pieces have had to be cut out by means of an oxy-acetylenic torch.

The cost of the works described cannot be exactly estimated. Expenses are mixed up with other administrative work, they are borne by the State budget.

For the three canals de l'Est (Northern branch) of the Ardennes and from the Aisne to the Marne, the repairs amounted, in 1919, to 29,650,000 francs.

32 millions of francs expenses must be provided for 1920.

By the end of the year, the three navigable waterways will be nearly in a fit state.

The works have been re-established with their former arrangements. However, the width of the bridges has been increased to leave causeways of 3 m. (3.28 yds.) or 5 m. 50 (6.1 yds.) width between pavements of 1 m. (1.09 yd.) width.

(From information supplied, in August 1920, by Mr. Hégly, *Ingénieur en chef des Ponts et Chaussées, Chef du Service de la Navigation, Canal de l'Est (branche Nord), Canal des Ardennes, Canal de l'Aisne à la Marne, Charleville (Ardennes).*

I. INLAND NAVIGATION

C. PORTS

PORT OF ROUEN (1)

Numerous wooden berths have been constructed in the fluvial port for empty or full peniches or barges.

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(1) See also *Ocean navigation*, p. 147.

II. OCEAN NAVIGATION

A. TIDAL RIVERS

THE MARITIME LOIRE AND THE PORT OF NANTES

1° Improvement works of the Loire, between Nantes and the sea (declared of public utility by the law of the 24th Dec., 1903).

These works of improvement have for object the allowing of ships of 7 m. 50 (24.5 ft.) draught to ascend to Nantes during the lowest neap tides. They comprise dredgings, freeing from rocks and destruction of islands, also the construction of dams for the materialisation of the plan of the bed to be made.

The fixed works had to be established so as to allow the circulation of ships with 7 m. 50 (24.5 ft.) draught at all times; but it was understood that the works should be directed at first to ensure the ascending of ships of 6 m. (19.7 ft.), the increase to the maximum water-draught of ships likely to circulate on the Loire to be obtained afterwards by dredging.

At the present time, the first part of the programme may be considered as achieved. The execution of the second part has been begun.

It was estimated that the works would cost the sum of 22 million 800,000 frs, this sum including a reserve of 2 million which had to be used for dredgings in view of the lowering of sills, to a sufficient depth to allow ships of 7 m. 50 (24.5 ft.) draught to circulate.

These works are being carried out at the present time so as to increase the depth already obtained.

It is, besides, intended to spend 10 million frs. on the improvement of the upstream section between Paimbœuf and Saint-Nazaire.

2° Improvement works of the port of Nantes (declared of public utility by the law of 7th July, 1913.)

These improvement works have for object to allow the port to meet the increase of traffic which will certainly be the consequence of the success of the improvement works of the maritime Loire. This traffic has gone from 1,553,660 tons in 1910 to

2,891,778 tons in 1916. It has oscillated since this year between a mixinum of 2,535,369 tons and a minimum of 1,708,581 tons.

The works referred to include:

a) The construction of 1,800 m. (about 1,967 yds.) of quay in the arm of the Pirnel, along which ships will find, at least a minimum of 8 m. (26.2 ft.) at the lowest tide;

b) The demolition and reconstruction of 2 large bridges which were in opposition to the normal diffusion of the tide above Nantes;

c) The construction of works upstream on the Loire to prevent sand being carried down stream, when the bridges forming an obstacle to their descent, will be taken away;

d) Dredgings and freeing from rocks;

e) The construction of a graving dock of 200 m. (218 yds.) available length.

The approved expenditure for improvement works in the port of Nantes was estimated to attain the sum of 28,500,000 francs, but, owing to the increase of prices at the present time, it would not be extraordinary if the outlay were to run to about 60 million francs.

The expenditure for the improvement of the Loire as well as for the improvement of the port, is borne half by the State or by interested parties: Chamber of Commerce, Conseil général de la Loire-Inférieure and town of Nantes. It is probable, that this will rapidly bring the port of Nantes to a yearly traffic which will attain, if it does not exceed it, 4 million tons. This traffic is two and a half times superior to that of 1910.

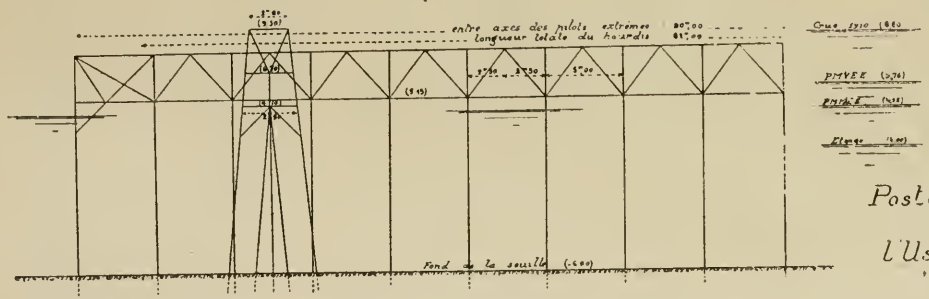
Other works have been carried out on the part of the Loire under consideration; we give a summary description of same here below.

a) *Wharves of the Usine Brûlée.*

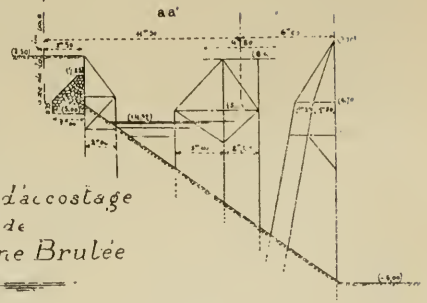
These wharves, begun in 1918 and finished in 1919, were built in a concavity situated on the right bank of the river, immediately below Roche-Maurice. They were decided on to allow an increase in the number of berths to be placed at the disposal of the American army in the port of Nantes. They are three in number.

(Fig. 1.)

Elevation partielle



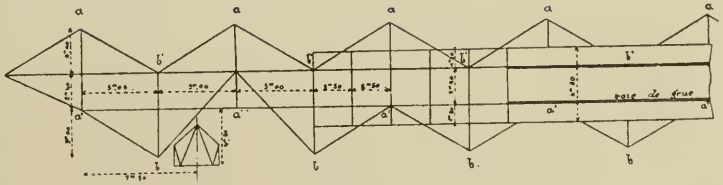
Coupes transversales

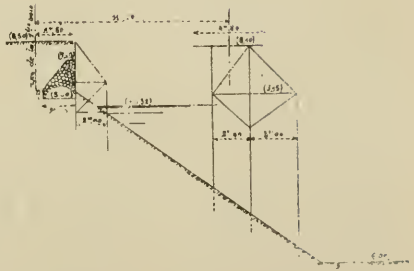


Poste d'accostage de l'Usine Brulée

Plans partiels

Coupe horizontale a (+5,15) hourdis enlevé avec hourdis





Each of these wharves is composed of three parts: Mooring-posts (called ducs d'Albe), at about 35 m. (38 yds.) distance from each other, at which boats can moor; a lifting crane wharf of 90 m. (98 yds.) length on which cranes having a minimum reaction of 27 t. 50 per roller can travel, a breast wall 15 m. (16.2 yds.) behind the front of the wharf which is composed of a curtain of planks sustained by coupled stakes.

At the foot of each wharf, a depth of 8 m. (26.24 ft.) under the lowest waters known, is found.

The expenditure, entirely borne by the State, has attained the sum of 815,000 francs in round figures.

The yearly increase of traffic to be hoped for, from the fact of the working of these wharves, will be about 100,000 tons per post, thus making 300,000 tons for the three posts.

b) *Paimbœuf wharf.*

This wharf, begun in 1916 and achieved in 1919, 250 m. (273 yds.) in length, was built in view of the chemical products factories, sulfuric acid and melinite, which were erected for the needs of war.

The work is connected with land by 2 girders inclined at about 45° to the direction of the bank. Each of these girders is about 75 m. (82 yds.) long. The whole of the work is constructed in concrete. The piles supporting the superstructure properly called are about 14 m. (15.2 yds.) in length, Mooring-berths, independent of the wharf, distant 35 m. (38 yds.) from each other allow boats to moor along the work. The depths to be found at its foot, are sufficient to allow of its use by boats of 5 m. 50 to 6 m. 50 (18 to 21.3 ft.) draught.

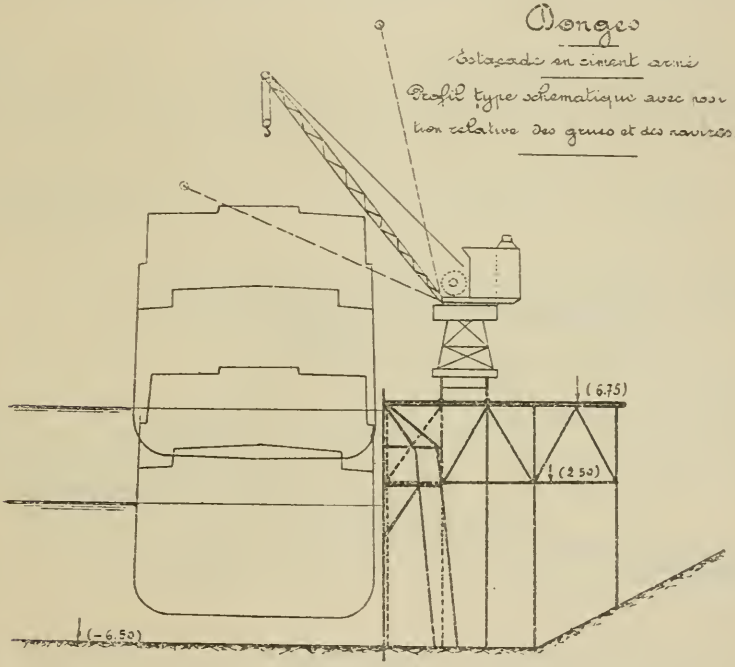
The wharf carries cranes having a maximum reaction per roller of 25 tons and a railroad on which wagons carrying 10 tons per axle can circulate.

The expense of carrying out this work, viz. 650,000 francs, was entirely borne by the « Administration des Poudres ». The traffic at this wharf will easily attain 100,000 tons yearly.

c) *Donges wharf.*

This wharf begun in 1918 and finished in 1919 (see plan hereannexed), 350 m. (378 yds.) in length, was built in view of

allowing the rapid unloading of coal consigned to the Compagnie d'Orléans and the loading of ore. It is connected with land by two gangways of 150 m. (164 yds.) length inclined at about 45° to the direction of the bank. Fifteen mooring-berths are placed in front of the work to allow the mooring of boats that will use it. The depth found at its foot is sufficient to allow of the mooring



(Fig. 2.)

Estacade en ciment armé = Reinforced cement wharf. — Profil type schématique avec position relative des grues et des navires = Section with relative positions of cranes and ships.

of boats having 8 m. (26.24 ft.) draught. The work is entirely constructed of ferro-cement.

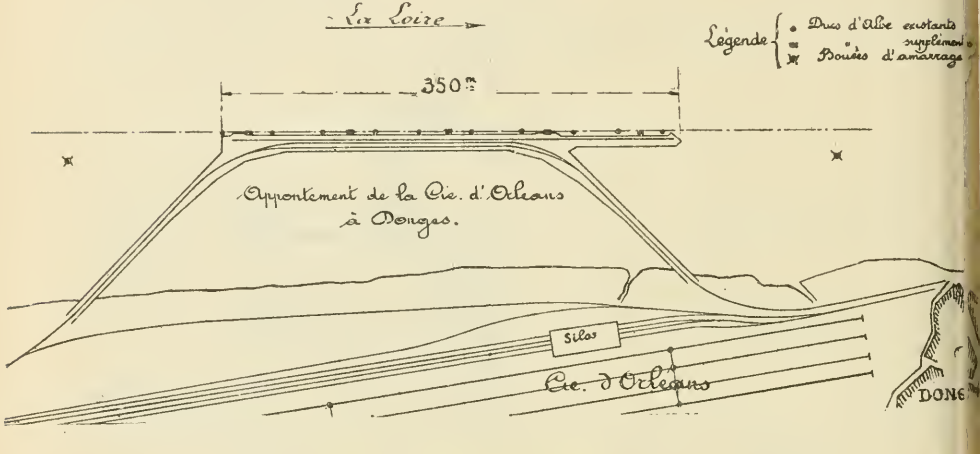
Its equipment will be undertaken by the Orleans Co. It will comprise 9 electric cranes of 5 tons, which will empty the coal on to conveyors connected with land.

The expenditure estimated at a total of 6 million francs, including the expenses for the maritime station and cost of purchase of ground, will be borne for a third by the State and for two-

thirds by the Compagnie d'Orléans, which will recover the advance it makes by the proceeds of a tax on ships and goods. It is probable that before very long the traffic at the wharf will exceed 1 million tons yearly.

d) *Construction of a post for the discharging of petroleum carried out by the Paix firm.*

The Paix firm constructed, in 1919, at about 1,200 m. (1,311 yds.) below the wharf of the Orleans Company, 4 mooring berths in ferro-cement at which petroleum ships will moor. The extre-



mity of a pipe delivering the petroleum and immerged in the river, will be fitted to a wooden wharf.

The berths mentioned are 500 m. (546 yds.) from the bank. Sufficient depths are found to allow the mooring of boats having 9 m. (29.5 ft.) draught.

The expenditure attained 1 million in round figures, it has been entirely paid by the Paix firm. It is estimated that the traffic will attain 300,000 tons of petroleum and mazout.

e) *Quays on piles below the Pirmil arm.*

These quays, begun in 1913 and finished in 1919, are included in the programme of improvement works of the port of Nantes declared of public utility by the law of the 7th of July, 1913.

To simplify matters, the original iron caissons have been replaced by movable wooden caissons in which a slab of cement of 2 m. (2.2 yds.) thickness has been run, capping the heads of the piles. This slab was strengthened at its inferior part by round irons. The tops of the stakes were united by trellised beams. This simplification of the primitive project has allowed the quay to be made under extremely satisfactory and rapid conditions.

The expenditure amounted to fr. 2,763,251.85. The Chamber of Commerce intervened for half of this sum. It is estimated that the quay will handle a traffic of 400,000 tons.

All of the works have been carried out under the direction of Mr. Kauffmann, Ingénieur en chef des Ponts et Chaussées.

(From information supplied, in May, 1920, by Mr. KAUFFMANN, *Ingénieur en chef des Ponts et Chaussées, 2, place de l'Edit de Nantes, Nantes.)*

Bibliography : La Loire et le port de Nantes, by Kauffmann, Ingénieur en chef des Ponts et Chaussées. *Annales des Ponts et Chaussées*, 1915, t. V, p. 164.

Works connected with Ocean and Inland navigation, 1913. The Loire and the Port of Nantes, p. 51 and 133.

THE MARITIME RANCE

Fixing of the channel at the crossing of the Lessart banks

The object of these works is to assure the regularity of navigation and to allow barges of 1 m. 60 to circulate without any stoppage between St-Malo and Rennes. They comprise, on the one hand, the construction of two dikes similar to the first one finished in 1910 and destined to fix the concave bank of the canal below the Chatelier on about 1,500 m. (1,639 yds.) and, on the other hand, to modify a point recognised as dangerous (ancient works of regularisation).

The expenditure is estimated at 340,000 francs of which 10,000 francs are contributed by the town of Dinan.

(From information supplied, in May, 1920, by Mr. Despujols, *Ingénieur des Ponts et Chaussées, at Saint-Malo.)*

II. OCEAN NAVIGATION

B. SHIPS CANALS

SHIP CANAL FROM CAEN TO THE SEA AND ITS PORTS

Extension of the quays of the new dock as far as the Calix bridge.

The object of this work is the construction of two new-discharging wharves for coal and minerals.

The new quay will be 365 m. (400 yds.) long with a depth of 7 m. 74 (25.4 ft.) and platforms at the back, 100 m. (109.36 yds.) long and 50 m. (54.7 yds.) wide.

The work was estimated, according to the preliminary scheme, at 1,900,000 francs, half of which is borne by the State and half by the Chamber of Commerce.

The estimate at present prices is 4,500,000 francs.

2° Widening and deepening of the canal (1)

The object to be attained is to make the port of Caen accessible to ships of 7 to 8,000 tons.

These works include the deepening to the level **0** with a bed-width of 37 m. 75 (41.26 yds.), depth 7 m. 74 (25.4 ft.) and recti-

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Translation of French terms :

General plan of the river Orne and the canal between Caen and the sea.

Widening and deepening of the canal from Caen to the sea.

Chantiers navals français = French naval dockyards. — Société normande de métallurgie = Metallurgic Company of Normandy. — Nouveau lit de l'Orne = New bed of river Orne. — Cours = Street. — Gare = Station. — Pont = Bridge. — Ecluse = Canal lock. — Bassin = Dock. — Nouveau barrage = New weir. — Ligne = Line. — Raccord = Connection. — Etat = State. — Cités ouvrières des C. N. F. — Workmen's quarters of C. N. F. — Enrochement = Enrockment. — Chenal = Channel. — La mer = The sea. — Bancs = Banks. — Rivière = River.

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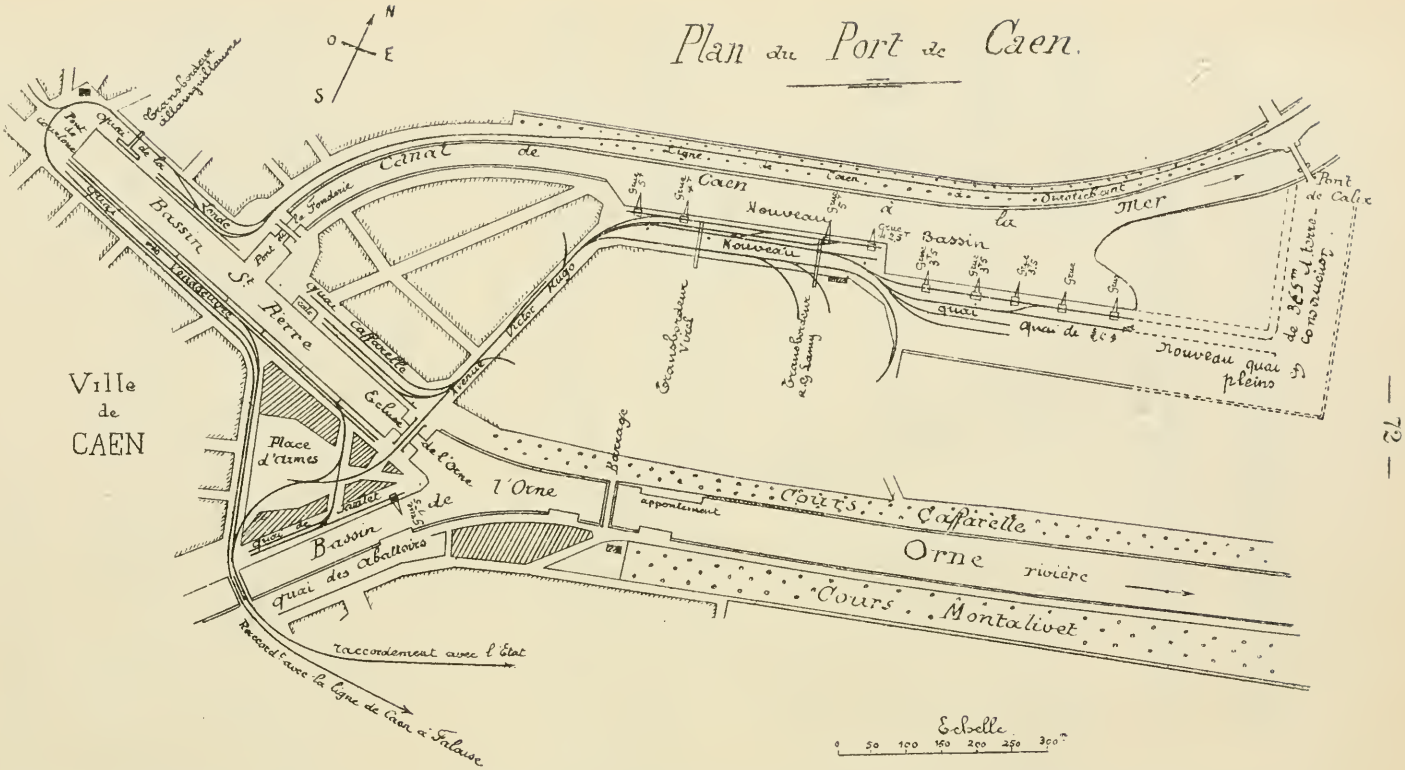
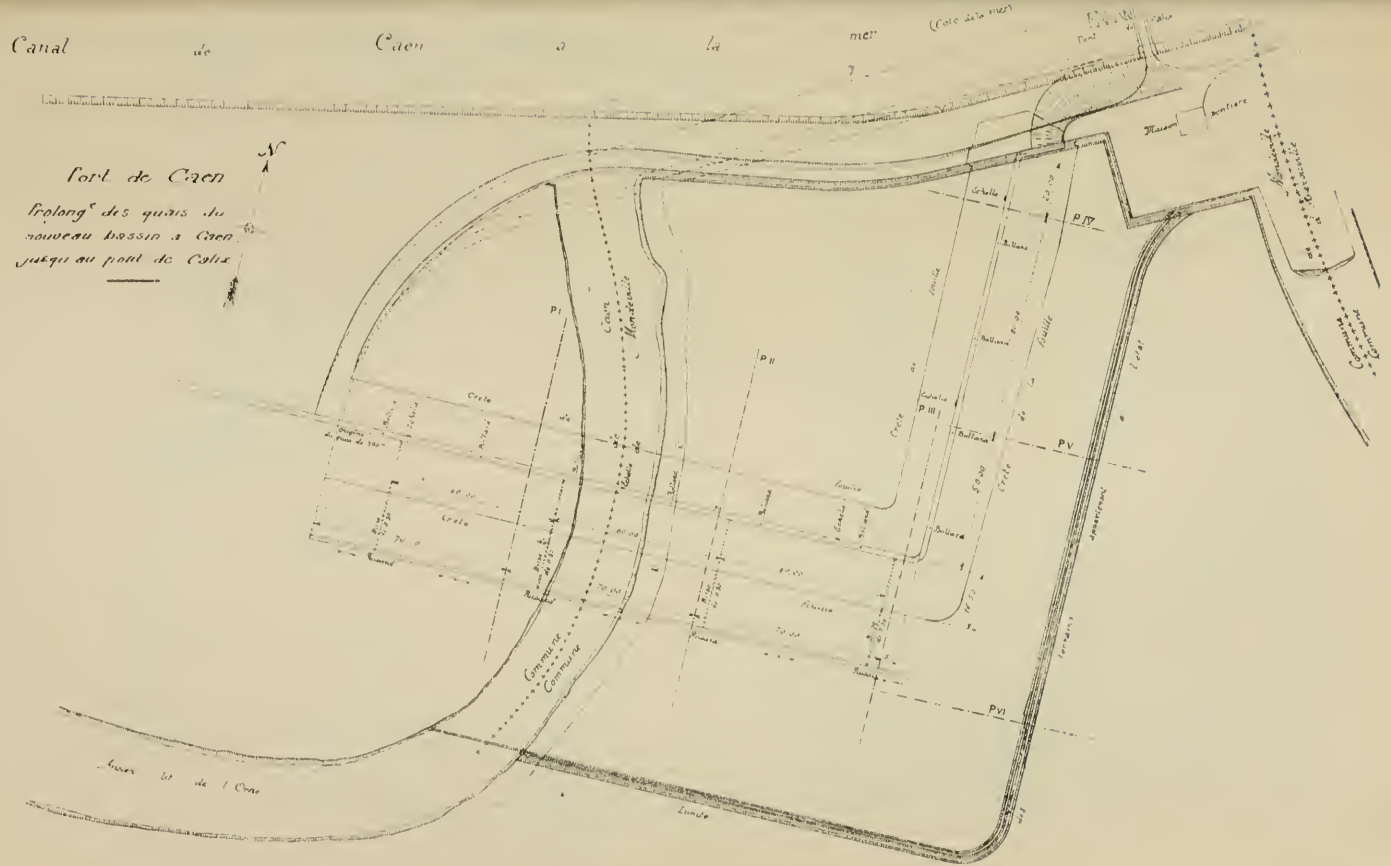
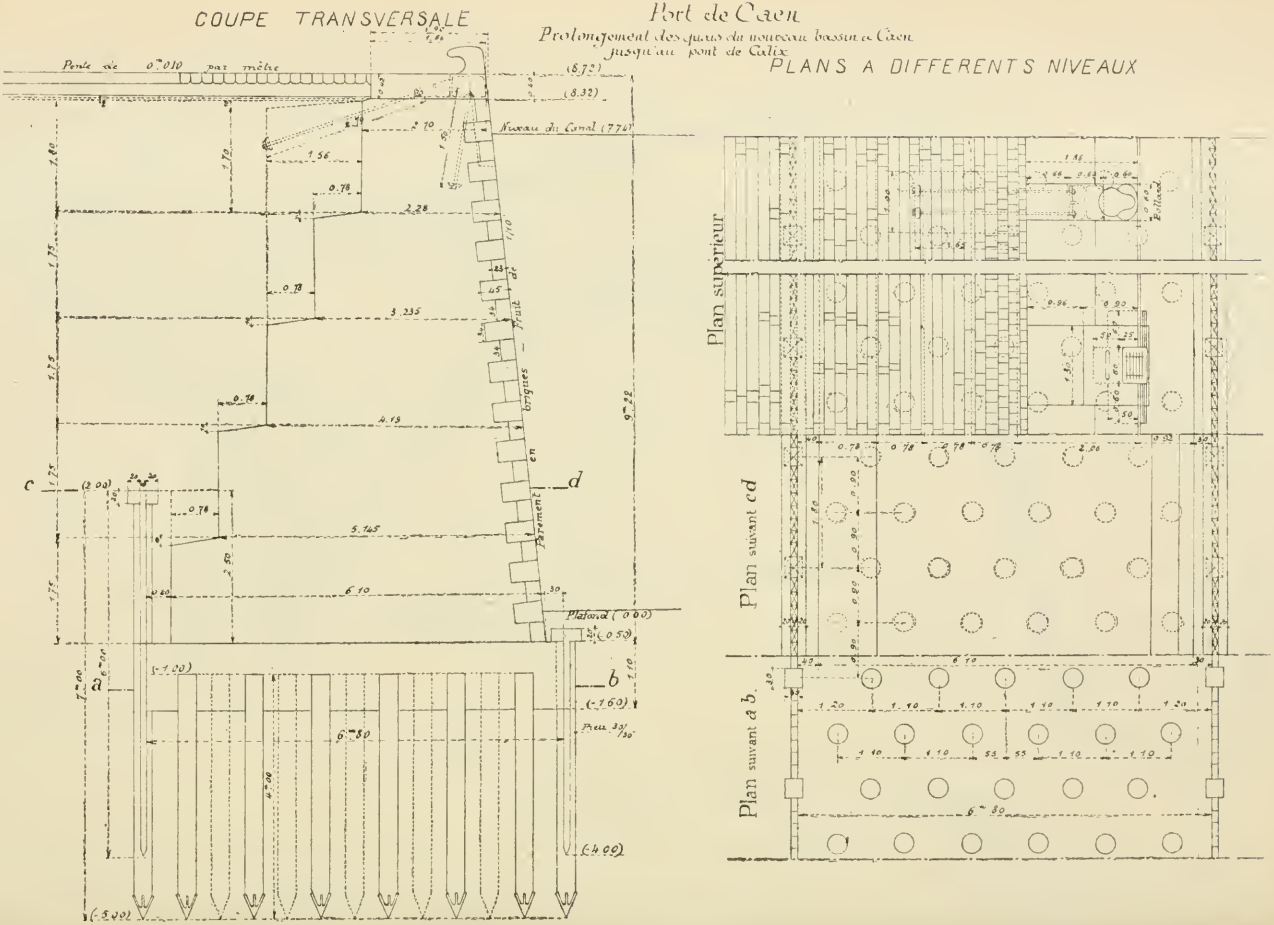
(1) See general plan of the canal.



Plan du port de Caen = Plan of the port of Caen. — Cours Montalivet = Montalivet street. — Bassin = Dock. — Rivière = River. — Appontement = Landing stage. — Nouveau quai de 365 mètres = New 400 yards quay and platform now building.



Port of Caen. — Prolongement des quais = Extension of the quays. — Du nouveau bassin à Caen jusqu'au pont de Calix = Of the new dock at Caen till the Calix bridge.


COUPE TRANSVERSALE
Port de Caen
Prolongement des quais du nouveau bassin de Caen jusqu'au pont de Calix
PLANS A DIFFERENTS NIVEAUX
Pente de 0m010 par mètre
Niveau du Canal (7.70)
Plan supérieur
Plan suivant cd
Plan suivant a b.

Port of Caen, — Extension of the quays of new dock at Caen to the Calix bridge.
Coupe traversale = Cross section. — Plans à différents niveaux = Plans at different levels.

L'ORNE
BANC DE L'ILLE.
Ouest.
CHENAL
Enrochement de l'Est.
BANCS
D'AMONT.
Enrochem.
Orne

Établissement et approfondissement du Canal de Caen à la mer
PLAN GENERAL DE LA RIVIERE D'ORNE ET DU CANAL
ENTRE CAEN ET LA MER
Cités ouvrières des C N F
CAEN
HEROUVILLE
BENOUVILLE
COLOMBELLES
RANVILLE
HERMANVILLE
CANAL
ORNE
MANCHE

fication of the curves the radius of which will be 1,500 m. (1,640.6 yds.) at least, the bed will be 50 m. (54.7 yds.) wide.

The works are estimated at 15,700,000 francs, of which

7,100,000	francs	is borne by	the State;
7,850,000	»	»	Chamber of Commerce;
500,000	»	»	Department;
250,000	»	»	Town of Caen.

3° Construction of a 200 m. (218 yd.) quay at the new dock of the port of Caen.

This quay has been constructed with a view to the establishment of discharging wharves. The quay is 200 m. long with a depth of 7 m. 74 and platform at the rear 100 m. (109 yds.) in width.

The original estimate for this work was 1,100,000 francs, of which sum 746,000 francs is borne by the Caen Chamber of Commerce. The cost amounted to fr. 1,425.852.70.

The works of the Canal and port of Caen are carried out under the supervision of Messrs Willote and Coblentz, Chief engineers, and Mr. Monseran, Engineer.

(From information supplied, in May, 1920, by Mr. Vasseur, *Ingénieur en chef des Ponts et Chaussées, at Caen.)* .

Bibliography : Works connected with Ocean and Inland Navigation, 1913, p. 55.

CETTE SHIP CANAL

Reconstruction works of the Montpellier swing bridge on the canal at Cette.

These works, authorised by decree of Dec. 26th, 1916, in consequence of the law of Dec. 23rd, 1903, are intended to give means of access to the Thau lake for sea-going vessels.

The channel of the swing-bridge is 30 m. (32.80 yds.) wide at the level of the towpath.

The metallic platform has a total length of 58 m. 709 (64.2 yds.) of which 21 m. 311 for the butt-end and 37 m. 398 for the span.

The cross-section presents a road 4 m. 70 (5 yds.) wide and two footpaths, on the corbelling, of 1 m. 50 (1.63 yds.), that is a total width of 8 m. 70 (9.4 yds.), including two wheel-guards 0 m. 50 (1.64 ft.) wide.

The total weight of the metal truss is 288 tons 507, to which it is necessary to add the weight of the sheeting equivalent to about 56 tons, that of the working equipment is 51 tons 223.

The bridge is worked by electricity. The rotation is assured by two roller-motors, each driven by a 25 HP. dynamo. These rollers run on a circular rail embedded in the masonry of the pit.

The fixing is assured by an electric motor of 25 HP. which drives the two gear machines placed on the main girders.

Each of these two gear machines worked by a screw is formed of a truck bearing three rollers fixed on their axles. The centre roller runs on a guide borne by the lower flange of the girder, the two lateral rollers run on the wedging-shoes cemented in the masonry. The running of the rollers on these shoes of an appropriate form brings about the balancing and wedging of the metal truss.

The pivot is formed of a steel spherical calotte covered by a bronze socket fixed under the rafter. Two rafter rollers, placed under each main girder, prevent it being reversed.

The time needed for wedging or unwedging is 15".

The time for opening or closing is 30".

The works have been carried under the direction of Mr. Domergue, Ingénieur en chef des Ponts et Chaussées, of Montpellier.

The total amount of the costs authorised is fr. 924,473.25.

The costs are borne by the State, the Chamber of Commerce, and the town of Cette in the following proportions:

State.....	fr. 283,293.52	fr. 924,473.25
Chamber of Commerce.....	636,005.31	
Town of Cette.....	5,174.42	

The Chamber of Commerce of Cette has been authorised by decree of Feb. 24th, 1913 to borrow a sum of 955,000 francs in view of the execution of the whole of the works authorised by the decree of Dec. 26th, 1912 and to levy a maximum toll of fr. 0.13 per ton on the registered tonnage of French and foreign vessels entering the port with a cargo, or coming to load in the port.

This tariff was reduced, before any toll was levied, to fr. 0.10 per ton, by a decree of the Minister of Trade, dated February 24th, 1913.

Are exempted from this toll:

1° The ships having made more than 7 voyages in the course of a year, for the voyages they will effect ultimately during the same year;

2° The vessels belonging to the State, or employed in its service;

3° The vessels employed as pilot boats, to mark boundaries, as tug-boats, for fishing, or as pleasure boats:

4° The vessels lying idle, and not undertaking any business operations;

5° The boats for inland navigation.

The sums produced annually by this tax, which was first levied on March 4th, 1913, are indicated herewith:

Year 1913 ..... fr.	63,152.37
» 1914	59,391.77
» 1915	74,739.33
» 1916	89,553.23
» 1917	69,176.79
» 1918	62,321.75
» 1919	60,524.36
Fr.	478,769.60

The costs of execution come out as follows:

a) According to the tenders:

1st lot: Levelling and masonry ..... fr.	242,000.00
2nd lot: Metallic truss and working equipment	550,000.00
3rd lot: Lime	10,973.25
4th lot: Cement	19,500.00
Administration	75,000.00
General initial expenditure	27,000.00
Fr.	924,473.25

b) According to the sums actually spent up to June 30th, 1920:

1st lot ..... fr.	239,047.79
2nd lot	511,369.86
3rd lot	11,340.00
4th lot	21,823.72
Administration	71,431.93
General initial expenditure	27,418.36
Fr.	882,431.66

The only alteration in the original scheme has been to replace the rough stone base, proposed as support to the concrete slabs which support the running track and the fixing mechanism, by suitable ironwork which has been simply placed on the site and the embankment.

(From information supplied, in July, 1920, by Mr. PIRARD, *Ingénieur en chef des Ponts et Chaussées, Montpellier.)*

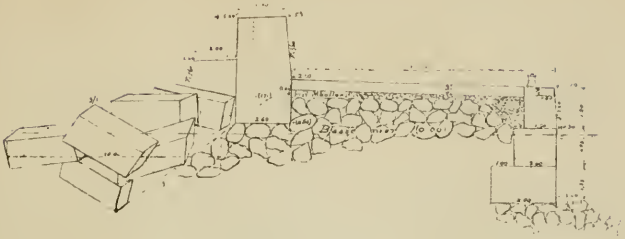
Bibliography: Works connected with Ocean and Inland Navigation, 1913, p. 101.

Canal de Marseille au Rhône

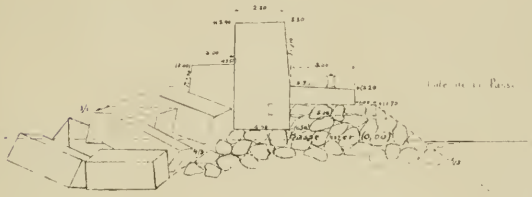
PORT DE LA LAVE

DIGUE du CANAL

Profil type A

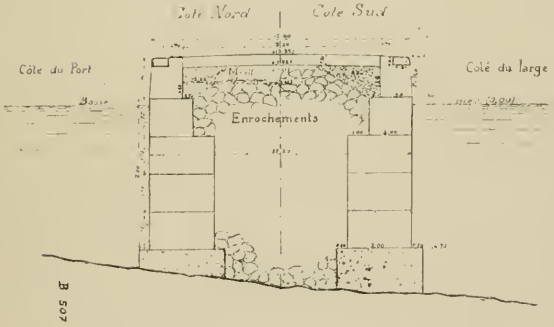


Profil type B



Profil en travers type C

vers bajoyer de la Passe.



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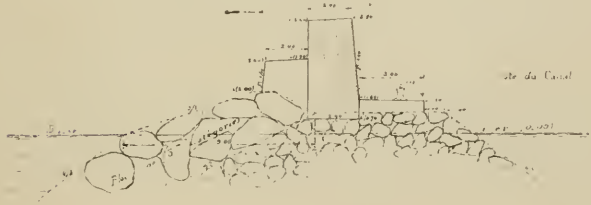
Profil-type D

Applicable sur les parties avec revêtement en blocs naturels



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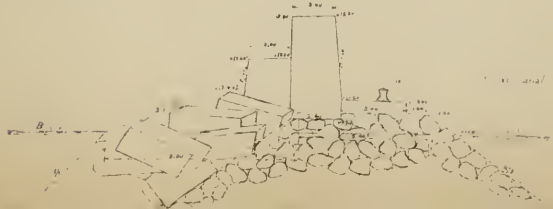


CANAL FROM MARSEILLES TO THE RHONE

Completion of the southern part of the port of La Lave, and completion of the dike protecting the maritime portion of the canal (1st section, part included between the port of Marseilles and the Rove tunnel).

The works proposed consist of:

1° The completion of the shelter-wall and of the berme of the outer dike of the port of La Lave, also of the quay-wall behind this dike;

2° The completion of the lateral walls North and South of the channel of Port La Lave;

3° The construction of a retaining-wall on the existing dike between the channel of Saumaty and the Port of La Lave, with outer berme and an inner footway for circulation.

The shelter-wall of the port of La Lave laid at the level + 0 m.50 (+1.64 ft.) (1) will have, at this level, a width of 2 m.60 (8.5 ft.); its upper surface will be leveled to +5 m. 50 (18 ft.). The berme will be 2 m. (6.56 ft.) wide at the level +3 m. 40 (11.1 ft.).

The quay and lateral walls are already constructed to the level +(0 m. 30), there remains their completion to +(2 m. 20), also of the platform behind the quay.

The shelter-wall of the canal dike built at the level +(0 m. 70) (2.29 ft.), will be 2 m. 40 (7.9 ft.) wide at this level and will be levelled to + (5 m. 50) (18 ft.); and the berme will 2 m. (6.56 ft.) wide at +(3 m. 40) (11.1 ft.) and the inner footway laid at +(1 m. 00) (3.28 ft.), will be 3 m. (9.84 ft.) wide.

The costs at pre-war prices were 1,350,000 francs; this sum will be greatly exceeded.

The works proposed form part of the construction works of the canal from Marseilles to the Rhone, the costs of which are divided

(1) All the altitude levels are brought to the zero of the scale of Fort-Saint-Jean. This level is about 0 m. 35 below the average sea-level and 0 m. 15 above the lowest sea-level observed.

between the State and the Chamber of Commerce of Marseilles.

The latter obtains the necessary funds by means of tolls levied on goods in transit through the ports of Marseilles.

Annexed is a plan of the types of sections adopted.

(From information supplied in July, 1920, by the Chief engineer, Service Maritime des Ponts et Chaussées, 1, quai de la Joliette, Marseilles.)

II. OCEAN NAVIGATION

C. SEA PORTS

PORT OF BORDEAUX (1)

1° Works decided on since 1910 and following years and which have not yet been executed.

A. *Extension of the dock of Bordeaux. Construction of new wet-docks* joined up by a new maritime canal to a new entrance with locks in Garonne, at the spot called « Grattequina » R. G. P. K. 12,000. (Act of the 15th July, 1910.)

The building of new wet-docks will give to Bordeaux, after their accomplishment, more than 5,000 m. (5,470 yds.) of new quays, without counting the banks of the canal, allowing of the construction of quays, jetties and wharves on a length of nearly 7,000 m. (7,650 yds.). The lock 225 m. (246 yds.) long and 30 m. (32.8 yds.) wide, will allow vessels drawing 8 m. 50 (27.9 ft.) to enter the dock at the lowest tides.

Estimate for the works .....fr.	33,995,000.00
Initial expenditure, including purchase of land	19,578,000.00
Anticipated increase for the works.....	42,000,000.00
» » of the initial expenditure	8,000,000.00
Total.....fr.	103,573,000.00

The costs are borne, half and half, by the State and the Chamber of Commerce.

* * *

B. *Reconstruction of the old vertical quays on the right bank* (from the Bourgogne quay to the Neuf quay). *Widening of the platforms on a length of 1,053 m. (1,151 yds.). A vertical quay to the right of the Quinconces slip. Straightening of the Fenwick slip.* (Act of the 15th July, 1910.)

The reconstruction of the old vertical quays will allow the largest vessels going up to Bordeaux to utilize the new works, and also to widen the platforms by 14 m. (46 ft.) on a length of more than 1 km. (1,609 yds.). (See fig. I.)

(1) See General plan.

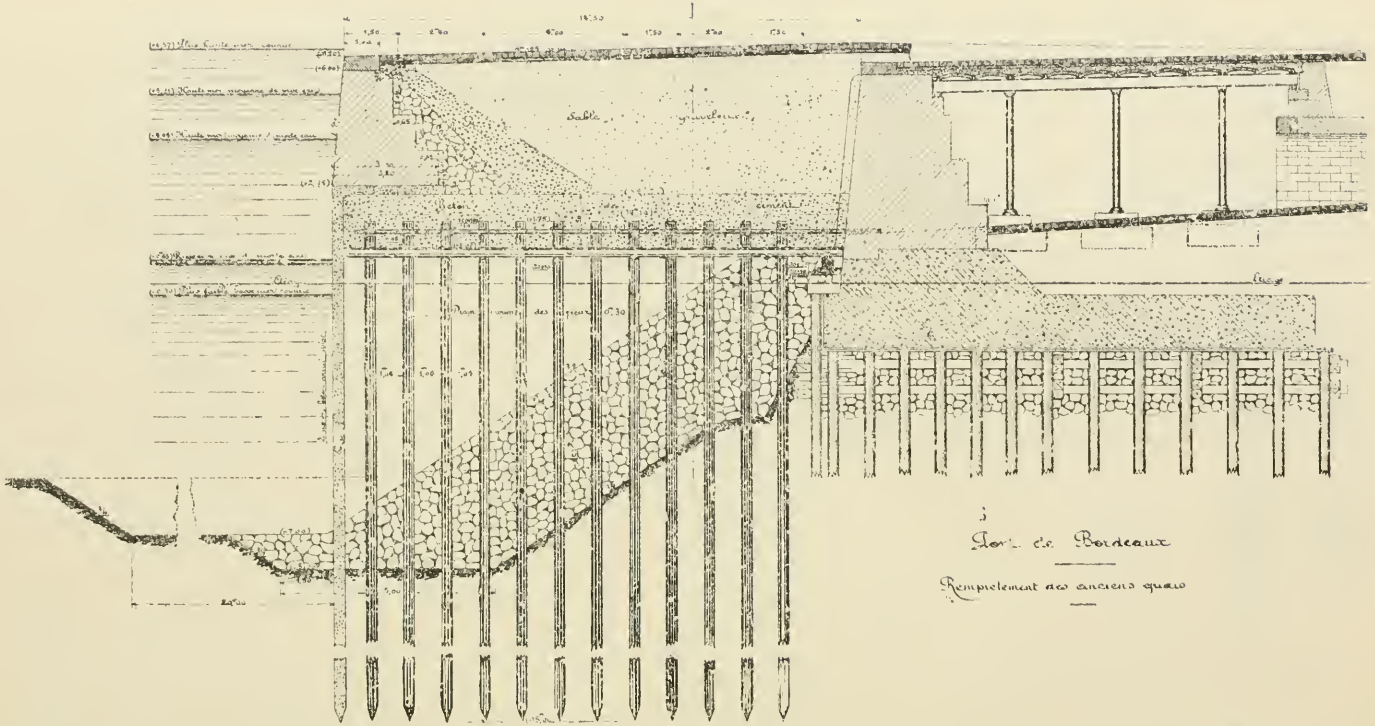


FIG. 1. — Rempiètement des anciens quais = Extension of the old quays. — Plus haute mer connue = Highest known tide. — Haute mer moyenne de vive eau = Average high tide. — Haute mer moyenne de morte eau = Average high neap tide. — Basse mer moyenne de morte eau = Average low neap tide. — Plus faible basse mer connue = Lowest known tide.

Estimated cost of works and initial expenditure ..... fr.	4,098,270.00
Anticipated increase.....	3,475,000.00
Total.....fr.	7,573,270.00

The costs will be divided in the same manner as for § A.

* * *

C. *Transformation of the Lucien Faure slip into a vertical quay on a length of 95 m. (104 yds.).* (Decree of 7th November, 1914.)

The transformation of this slip gives a new wharf to the left bank, the immediate building of which is under consideration, in order to supply commerce with a part of the berths which will be successively occupied by the reconstruction yards. (See fig. 2.)

Original estimate for the works.....fr.	470,000.00
Anticipated increase	470,000.00
Total.....fr.	940,000.00

The costs will be divided in the same manner as for § A.

* * *

D. *Transformation of the Richelieu slip into a vertical quay on a length of 83 m. (90.6 yds.).* (Decree of the 5th of June, 1915.)

The transformation into a vertical quay of the Richelieu slip, like that of the Quinconces slip, originally included in the programme of 1910, is closely connected with the reconstruction of the whole of the old quays, which will leave only the Fenwick slip.

Original estimate for the works .....fr.	780,000.00
Anticipated increase	780,000.00
Total.....fr.	1,560,000.00

The costs will be divided in the same manner as for § A.

* * *

E. *Wharf and grain unloader for the « Grands Moulins de Bordeaux »*, at berth 000 of Queyries. (The concession for this

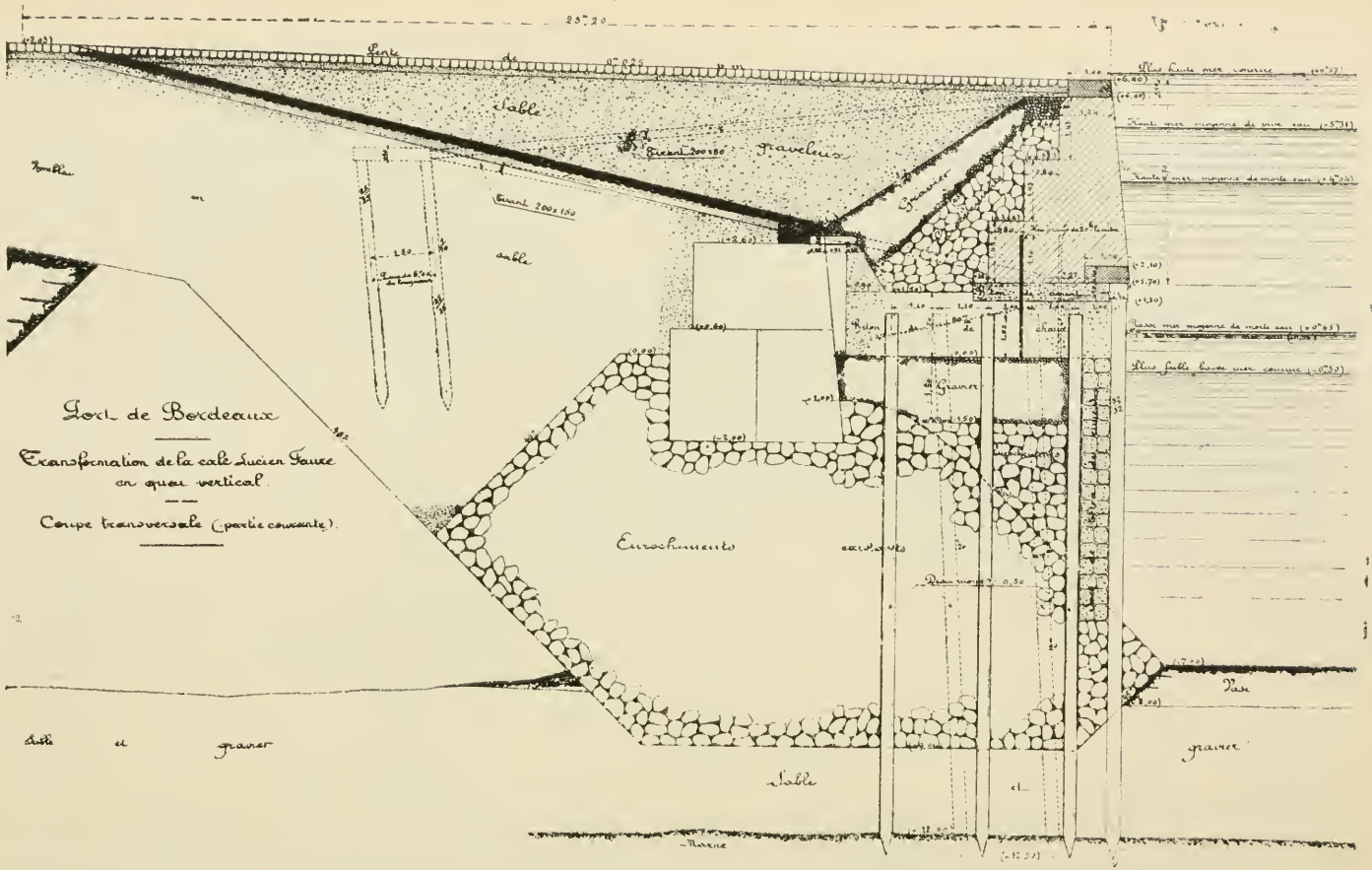


FIG. 2. — Transformation de la cale Lucien Faure en quai vertical = Transformation of the Lucien Faure slip into a vertical quay. — Coupe transversale = Cross section. — Enrochements = Enrockments. — Sable = Sand. — Vase = Mud. — Gravier = Gravel. — Pente de 0 m, 025 = Slope 1 : 40.

work is authorised in principle, and has been submitted to the higher Administration for its definite consent.)

The wharf will be lengthened by 60 m. (65.6 yds.) according to the type of timber-wharves of Queyries. The grain from the boats will be unloaded by means of a suction pipe and deposited on an underground moving belt which will carry it to the pits of the mill situated behind the wharf. Expected output: 3,000 quintals (cwts.) per day.

The estimates have not been made out; the cost of the work will be entirely borne by the concessionaire.

* * *

F. — *The lay-out of three groups of sidings and shunting lines* to serve the new docks. (Taken into consideration by decree of the 1st September, 1914.)

These groups should allow of serving docks 2 to 7, each group corresponding to a group of two docks. The head of the three groups will be joined up to the junction line Midi-Médoc and to the line Saint-Louis-Pointe de Grave, and also to Saint-Louis Station.

Total estimate for the works ..... Fr. 8,000,000.00

Purchase of lands and understructure at the expense of the State, who asks for the cooperation of the Chamber of Commerce for half the real expenses of the project.

Superstructure, plant and material, at the expense of the Company.

* * *

G. — Besides the works specified in what precedes, the law of the 15th July, 1910 includes the *improvement of the entrance to Bordeaux* by means of dredgings and arrangement of the bed. The works are in hand and have already produced appreciable results.

They should allow ships drawing 8 m (26 1/4 ft.) to come up at any time, and, with average water, ships drawing 8 m. 50 (27.88 ft.).

The estimated expense is ..... Fr. 20,000,000.00 divided up as for § A.

2° Works finished.

A. — *Transformation of the Douane Slip* into a vertical quay on a length of 198 m. (216 yds.). Quay on arches, with piles sunk by compressed air. (Law of the 15th July, 1910.)

The creation of this new berth is to provide an accessory one for when the reconstruction is commenced, thus giving to commerce a supplementary quay in exchange for one rendered unavailable by reason of the works.

Authorised expenditure	Enterprise..... fr.	1,879,659.25
	Initial expenditure .	200,362.50
Expended.....	Enterprise..... fr.	1,785,441.32
	Initial expenditure .	154,838.92
Increases by a transactional indemnity.....		300,000.00

The State and the Chamber of Commerce each bear half of the expenses.

* * *

B. — *Lengthening of the Queyries wharves* by a new up-stream berth, made of timber, and called « poste 000 ».

This berth has been constructed with a length of 120 m. (130 yds.) to answer to the regularly increasing needs of this part of the port.

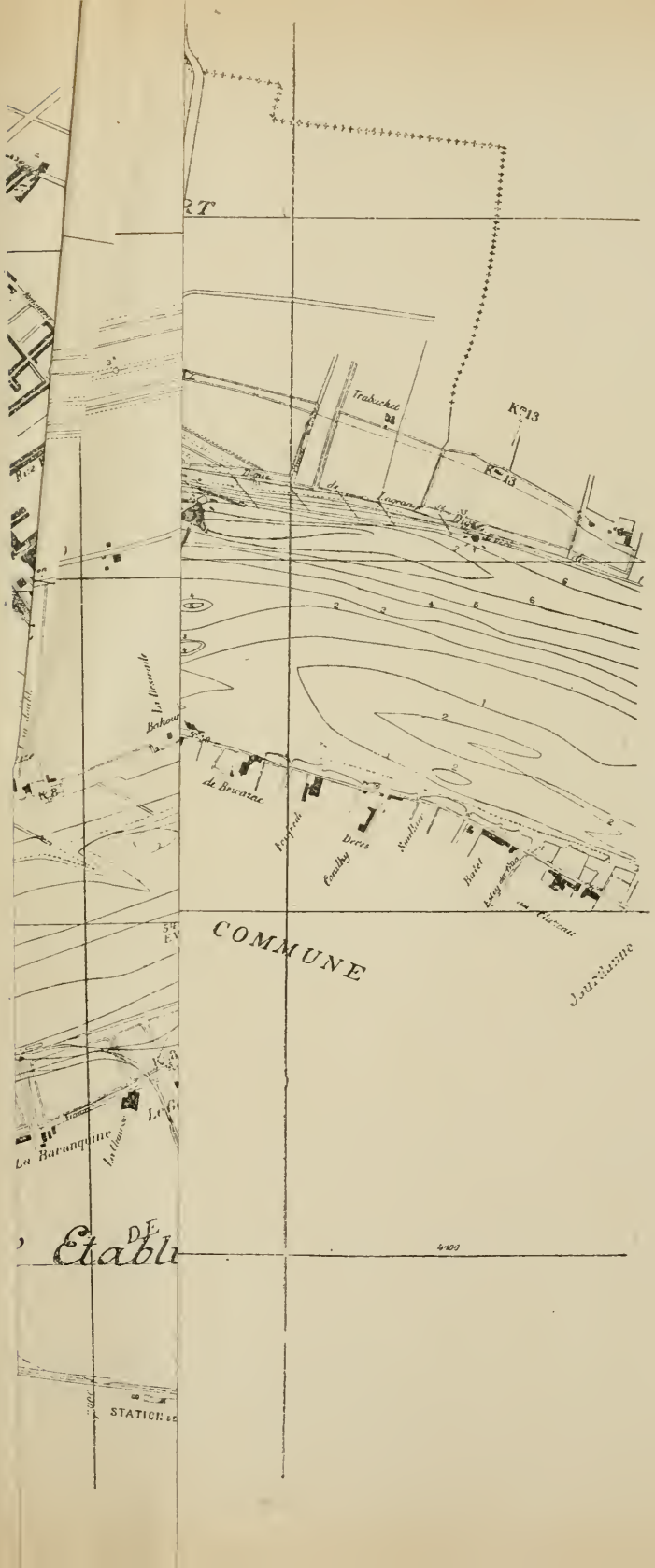
Authorised expenditure	Entreprise..... fr.	456,000.00
	Initial expenditure .	38,184.07
Expended.....	Entreprise..... fr.	456,000.00
	Initial expenditure .	38,183.96

A quarter of the expenses were borne by the State and three-quarters by the Chamber of Commerce.

* * *

C. — *Jetties* for lighters and barges for inland navigation.

These jetties, actually four in number (a double one on the right bank and three on the left bank) have for object the landing, elsewhere than at the quays for ocean-going ships, of goods already transhipped from ocean-going ships to lighters.


RT
Trabuchet
Kes 13
Kes 13
Rue
Bahaud
La Baranquine
COMMUNE
Etabli
DE
STATION

COMMUNE DE BLANQUEFORT
COMMUNE DE BORDEAUX
COMMUNE
COMMUNE
BASSENS
FORMONT
Extension de l'Etablissement à flei
Echelle de 17 pour 10 mètres

Their lengths are respectively:

L. B., downstream jetty	20 m. 80	(22.7 yds.)
L. B., jetty between the 2 bridges...	13 m.	(14 yds.)
L. B., upstream jetty	18 m. 45	(20,65 yds.)
R. B., upstream jetty « poste 000 » ..	30 m. 80	(33.7 yds.)

Authorised expenditure	Enterprise..... fr.	357,900.00
	Initial expenditure .	12,100.00
Expended.....	Enterprise..... fr.	309,260.00
	Initial expenditure .	28,449.18

The fifth jetty provided for has not yet been built.

The costs are borne by the State.

* * *

D. — *Wooden warehouses* for perishable goods.

Light wooden buildings put up to protect the large stocks of perishable goods received at Bordeaux.

The area covered is about 18,500 m2 (195,600 sq. ft.) (public warehouses).

Authorised expenditure	Enterprise..... fr.	295,645.50
	Initial expenditure .	14,354.50
Expended.....	Enterprise..... fr.	263,574,54
	Initial expenditure .	11,817.60

The costs are borne by the State.

* * *

E. — *Lines on the quay, shunting lines.*

On the two banks of the Garonne, in the port of Bordeaux itself, the lines on the quays have been increased by a total length of 21,688 m. (23,715 yds.) since 1914 in order to improve the conditions of service of ships and warehouses.

(From information supplied, in May, 1920, by Mr. Clavel, *Inspecteur général des Ponts et Chaussées, 2, rue Jean-Jacques-Bel, Bordeaux.)*

Bibliography: Works connected with Ocean and Inland Navigation, 1913, p. 63.

PORT OF BORDEAUX-BASSENS

1° Works decided on since 1918.

A. — *Wharf fitted with plant for the rapid handling and storing of cereals.*

This work 130 m. (141 yds.) long, for ocean-going ships, should allow of unloading cereals at the rate of 300 tons per hour, for placing same in pits, in sacks and storage. (See fig. I.)

* * *

B. — *Wharf fitted with plant for the rapid handling of coal and heavy matters.*

This wharf 390 m. (426 yds.) long, for ocean-going ships, has three berths, two of which are for unloading coal and one for loading into bunkers. The unloading will be done at the rate of 400 tons an hour.

The two installations specified above have been conceded to a company « Union Commerciale de Bordeaux-Bassens » which undertakes to pay all expenses connected with deepening and maintaining the depth at the wharves, and works under limited tariffs, paying an annual royalty to the State, and a levy to the latter on the total receipts when they go beyond a certain figure.

* * *

C. — *Unloading wharves with handling plant and warehouse for masut.*

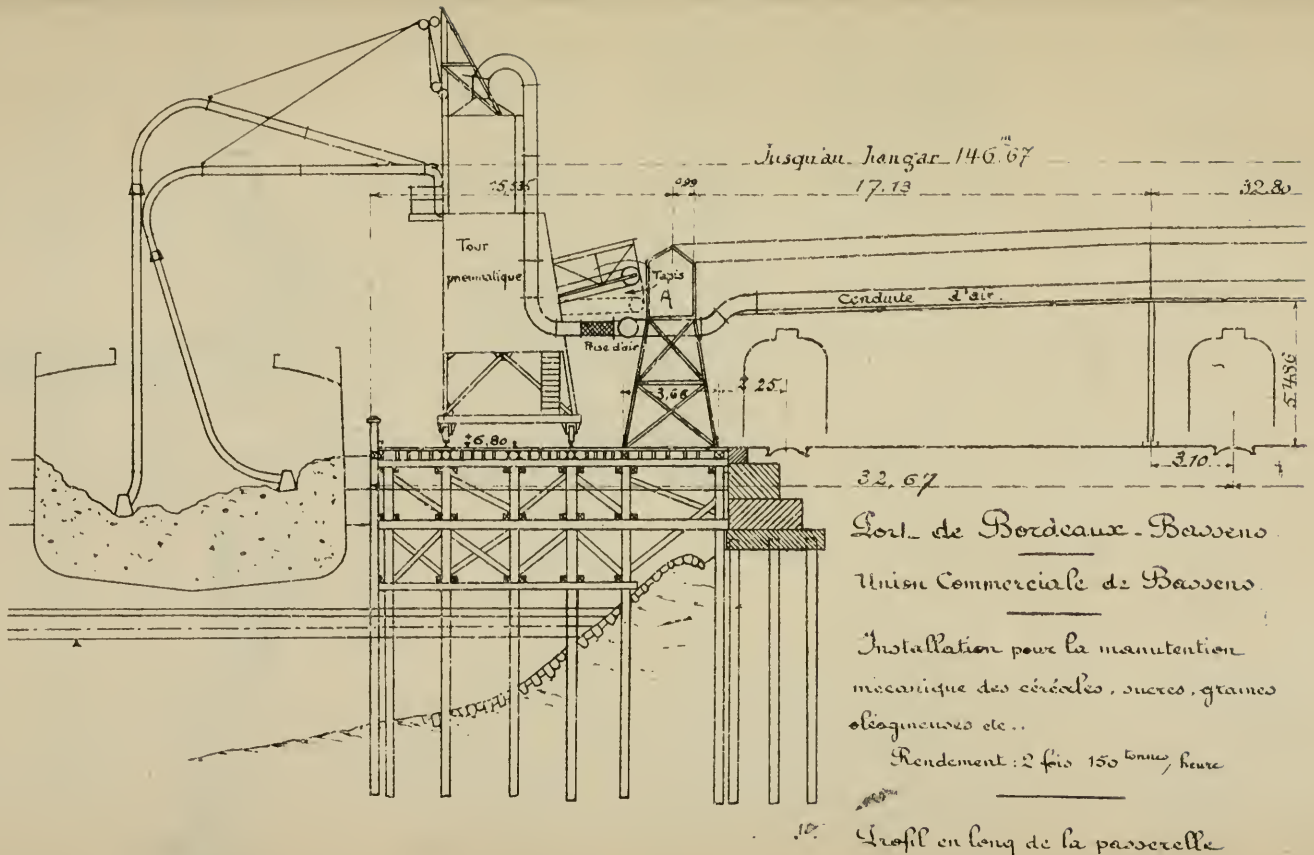
These installations form the object of an authorisation to equip privately, with public service compulsory, all expenses being

---

Translation of French terms p. 91

Fig. 1

Jusqu'au hangar 146 m. 67 = To warehouse 160 yds. — Tour pneumatique = Pneumatic tower. — Conduite d'air = Air pipe. — Installation pour la manutention mécanique des céréales, sucres, graines oléagineuses, etc. = Installation for the mechanical handling of cereals, sugar, oleaginous seeds, etc. — Rendement : 2 fois 150 tonnes/heure = Output : twice 150 tons per hour. — Profil en long de la passerelle perpendiculaire a la riviere. — Longitudinal section of the gangway perpendicular to the river.



Port de Bordeaux - Bassens

Union Commerciale de Bassens

Installation pour la manutention mécanique des céréales, sucres, graines oléagineuses etc..

Rendement : 2 fois 150 tonnes / heure

10 Profil en long de la passerelle perpendiculaire à la rivière

borne by the party receiving the authorisation (Maison les fils de A. Deutsch).

The unloading stations with fenders include a berth for 150 m. (490 ft.) ships and one for barges for distributing masut, with pumping station, conduits, tanks, railway tracks for transporting by land.

2° Works finished between 1914 and 1919.

A. — *Bassens-Amont wharves* (fig. 2).

These wharves for ocean-going ships, put up under the direction of Mr. Clavel, Inspecteur Général des Ponts et Chaussées, and extending for a length of 1,250 m. (1,367 yds.), are built of timber, with a masonry wall behind, and are served by 29 steam-cranes. Vast warehouses, platforms and numerous railway lines are found behind.

The cost of the works, including the purchase of land, was 6,245,090 francs.

The actual expenses amounted to 6,469,945 francs; they were entirely borne by the State, in any case provisionally. (Built for war purposes.)

B. — *Bassens-Aval wharves* (fig. 3).

These wharves for ocean-going ships, built by the Corps of Engineers of the American base with the cooperation of the maritime service of the Gironde, on a length of 1,250 m. (1,367 yds.), are entirely of timber, with warehouses, platforms and railway lines behind.

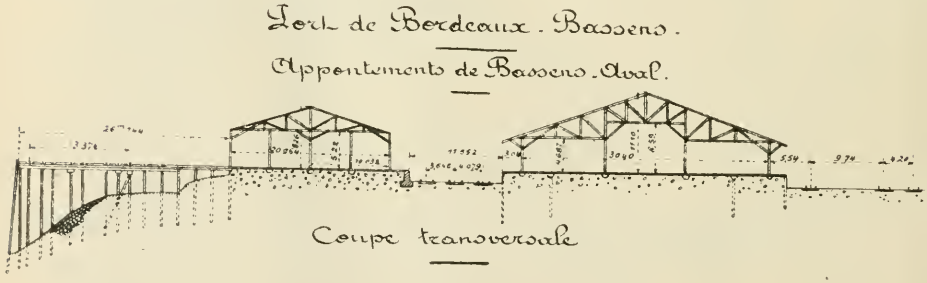
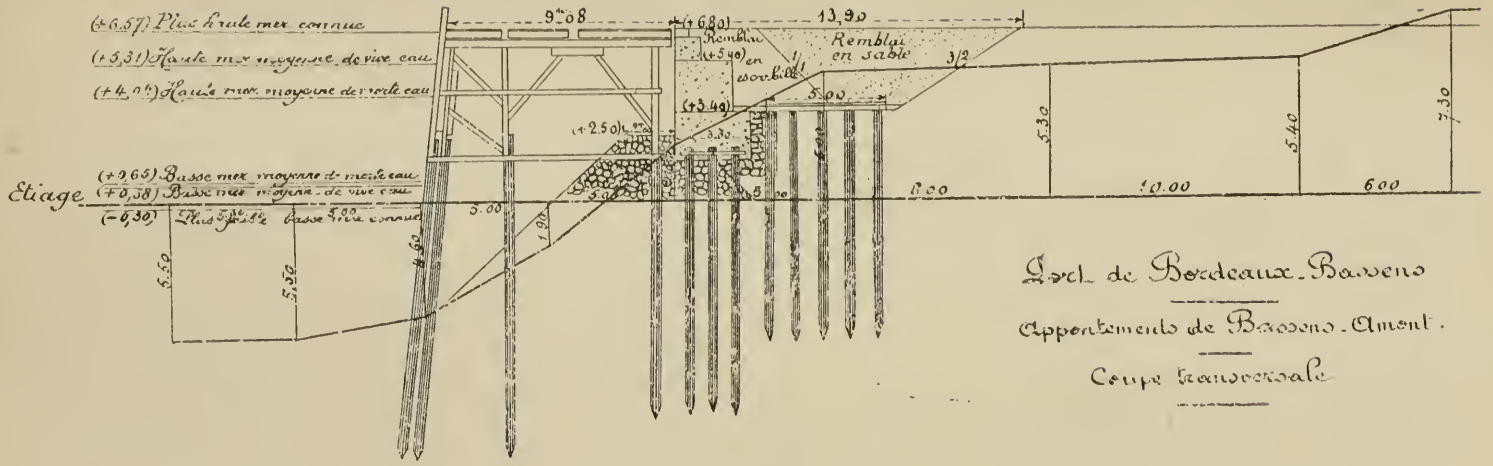


Fig. 3

Appontements de Bassens-Aval = Bassens-Aval wharves. — Coupe transversale = Cross section.



— 93 —

FIG. 2

(+ 6.57) Plus haute mer connue = (+ 21.55 ft.) Highest known tide. — (+ 5.31) Haute mer moyenne de vive eau = (+ 17.4 ft.) Average high tide. — (+ 4.04) Haute mer moyenne de morte eau = (+ 13 25 ft). Average high neaptide. — Etiage = low water mark. — (+ 0.65) Basse mer moyenne de morte eau = (+ 2.12 ft.) Average low neap tide. — (+ 0.58) Basse mer moyenne de vive eau = (1.9 ft.) Average low tide. — (— 0.30) Plus faible basse mer connue = (— 1 ft.) Lowest known tide. — Remblai en escarbille (en sable) = Cinder (sand) filling. — Appontements de Bassens-Amont — Bassens-Amont wharves. — Coupe transversale = Cross section.

They are served by 40 electric gantry cranes.

Altogether, the covered warehouses measure 51,000 m2 (608,760 sq. ft.) ; the installations also include a cold store to hold 10,000 tons of frozen meat. The roads have a total length of 90,560 m. (99,000 yds.).

The wharves are supplied with water and electric current.

These works were constructed during the war, for war purposes ; they are now for commercial uses.

(From information supplied, in May 1920, by Mr. Clavel, *Inspecteur Général des Ponts et Chaussées, Chef du Service maritime de la Gironde, 2, rue Jean-Jacques-Bel, Bordeaux.)*

THE PORTS OF BORDEAUX AND OF THE GIRONDE

(Improvement and extension)

1° The construction of an outer harbour in deep water, at the Verdon.

The object in view is the creation, at the mouth of the Gironde itself, of a foreport and a port of call capable of receiving ships of the largest tonnage, supplied with up-to-date installations for the reception of passengers and fast goods traffic.

The scheme provides for a mole 600 m. (656 yds.) in length with accomodation on both sides (656 yds. on the sea side, 353 yds. on the inner side), connected with the shore by a viaduct.

By reason of the increase in prices, a reduction in the dimensions of the work is actually under consideration. (See general plan herewith.)

The estimates for the scheme of 1913 amounted to 24 millions of francs, which was to be supported by the Bordeaux Chamber of Commerce, the concessionaires.

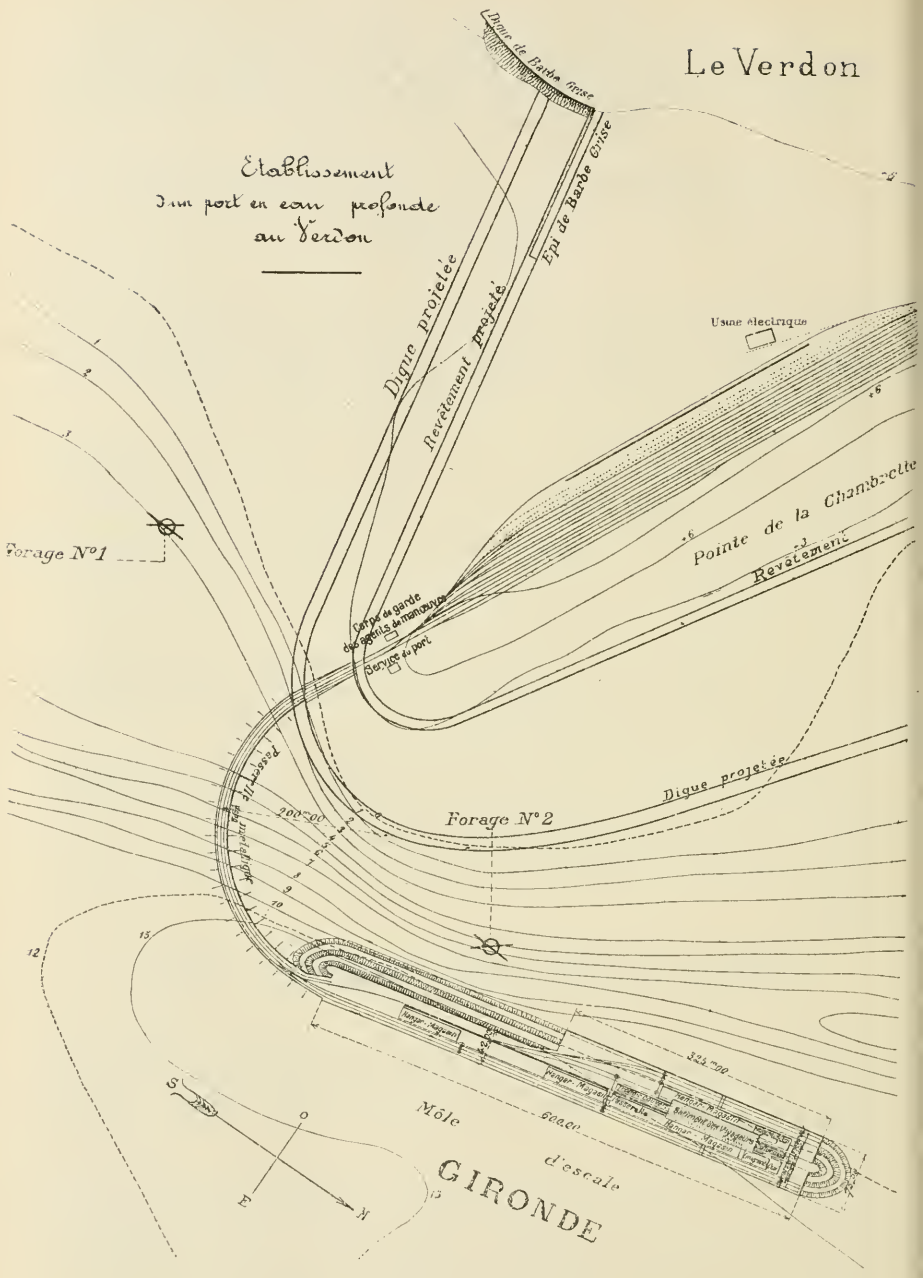
Negociations have been entered into with a view to the execution of the works by an association of this Chamber of Commerce and the Midi and Orleans Railway Companies.

The financial study of the matter on a new basis is not yet finished.

2° Wharves for large steamers for the Port of Blaye.

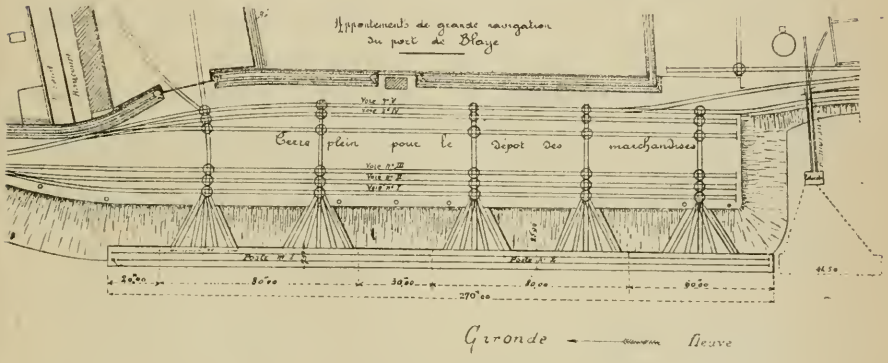
A timber quay-wharf 270 m. (255 yds.) long, connected with the shore by means of jetties for roads and destined to accomodate ocean-going ships, supplied with 9 cranes and 3,793 m. (4,146 yds.) of road way.

The object of this work was to form a receiving centre for coal. Considered in principle in 1914, it was decided on and completed during the war for the needs of this latter. It was especially employed for stocks of coal for Italy and is at present used for stocks for supplying France. (Herewith a plan.)


Le Verdon
Établissement
d'un port en eau profonde
au Verdon
Digue de Barbe Grise
Epi de Barbe Grise
Digue projetée
Revêtement projeté
Usine électrique
Pointe de la Chambrette
Revêtement
Forage N°1
Forage N°2
Digue projetée
Passe projetée
Môle d'escale
GIRONDE
N
S
E
O

The work was performed under the direction of Mr. Clavel, Inspecteur Général des Ponts et Chaussées, Chef du Service maritime de la Gironde, at Bordeaux.

The cost of the authorised works amounted to 1,660,000 francs of which 540,000 francs were borne by the State and 1,120,000 francs by the Bordeaux Chamber of Commerce.



The real cost was 1,654,672 francs.

The importations were :

In 1915	.....	29,867 tons
In 1916	.....	99,581 tons
In 1917	.....	300,516 tons
In 1918	.....	538,835 tons
In 1919	.....	181,027 tons

The building of two berths, commenced in June, 1915, was finished in September, 1916.

The connecting up and building of a third berth was commenced in January 1918 and finished in 1919.

(From information supplied, in May, 1920, by Mr. Clavel, *Inspecteur Général des Ponts et Chaussées, 2, rue Jean-Jacques-Bel, Bordeaux.)*

BREST (Naval port)

Construction of two large graving docks at Laninon

The two docks which give on to the sheltered roads, are closed by means of gates on wheels and supplied with ferro-concrete blocks.

The object is to dote the navy with the means of careening the largest warships in service or of which the building is intended.

The length at first decided on for the two docks, which are identical, was 200 m. (656 ft.) ; but, while in course of construction, this was increased by 50 m. (164 ft.).

The following are the principal dimensions of each dock :

Available length	250 m. (820 ft.).
Width of entrance lock	36 m. (118 ft.).
Height of sill in relation to « o » of the charts	8 m. (26.24 ft.).

The dimensions of the gates on wheels are as follows :

Outside length	37 m. 80 (41.4 yds.)
Outside width	7 m. 80 (8.5 yds.)
Height of the axis of the upper girder above the wheel-track	17 m. 46 (19.08 yds.)

The entrance lock has a rectangular section.

The works were executed under the superintendence of Engineers of the Ponts et Chaussées, attached to the Service Naval des Travaux hydrauliques. at Brest, to wit :

From 1910 to 1913, Mr. Bezault, Ingénieur en chef, Directeur des Travaux hydrauliques, and Mr. Thévenot, Ingénieur ordinaire, attached to the same service.

From 1913 to date, Mr. Mallat, Ingénieur en chef, later Inspecteur général, Directeur des Travaux hydrauliques. and Mr. Thé-

venot, Ingenieur ordinaire, later Ingénieur en chef, attached to the same service.

During the sinking, by compressed air, of the ferro-concrete caissons, in three of the caissons, the working chamber got detached from the upper masonry. An account in the *Annales des Ponts et Chaussées* (see Bibliography), shows the means adopted to make sure of the solidity between the working chamber and the upper part.

At the time of the contract for the principal work (levelling and masonry), the total expenses were estimated at 14,600,000 francs.

According to the sums really expended (some works have still to be paid), the same expenses will amount to 17,500,000 francs in round figures.

The increase will have been therefore about 3 million francs.

This increase is due:

1° To the lengthening of the docks from 218 yds. to 272 yds. and the suppression of the longitudinal slope of the sill;

2° To the execution of certain accessory works, not provided for at first, such as reinforced-concrete reservoir and the canalizations for the submersion of the bunkers of ships stranded in the docks;

3° To the revision of the prices of certain contracts and to the granting of certain indemnities to contractors for executing during the war, work contracted for before the hostilities;

4° To the increase, in comparison with the estimates, of the prices for works or supplies the contracts for which were given during the war (especially the making of reinforced-concrete blocks and the supply of filling and suction sluices).

The most important part of the works (levelling and masonry), was the object of a contract dated the 25th of March, 1910, and the works were effectively undertaken about the 14th of the following July. The other works (gates, blocks, etc.), were the object of distinct contracts, but the duration of the whole of the works was, in fact, determined by the time necessary for the execution of the principal contract of the 25th March, 1910. This time was five years, the works ought to have been finished in 1915.

They would have been but for the war; because of this latter, they were only terminated in 1919. The two docks could however be utilized, one in May, 1918 and the other in March, 1919.

(From information supplied, in July, 1920, by Mr. Mallat, *Inspecteur Général des Ponts et Chaussées, Directeur des Travaux hydrauliques de la Marine, at Brest, 42, rue du Château, Brest, Finistère.)*

Bibliography : Bezault et Thévenot. — Construction de deux formes de radoub sur les terre-pleins de Laninon, au port militaire de Brest. *Annales des Ponts et Chaussées*, 1913, fasc. II, p. 260.

Works connected with Ocean and Inland Navigation, 1913, p. 91.

PORT OF CALAIS

1° Construction of a terminus station for ferry-boats to the right of the wood dock of the Carnot basin.

The object of the terminus (see figure herewith) is to allow of the direct landing and embarking of wagons and vehicles of all kinds on and from the deck of the ship. The oscillating gangway is provided to redeem, without the up or down slope exceeding 5.6 p. c., a maximum difference of 3 m. 41 (11.18 ft.) between the position of the loaded vessel with the minimum level of the basin and the position of the lighter with the maximum level of the basin. It will carry two railway tracks, have a width of 7 m. 65 (25 ft.) and a length of 30 m. 48 (33.2 yds.); its weight will be 100 tons. The movable end is suspended to a portico which carries the mechanism, the working winches and the balancing counterweights.

The work has also wooden blocks regulating exactly the mooring of the boat so as to ensure the continuity of the rails. The vessel has a length of 111 m. (364 ft.), a width of 18 m. 75 (61.5 ft.) and an average draught of 2 m. 90 (9.5 ft.). It is moored alongside 3 ferro-concrete piles 6 m. 80 × 6 m. 80 (7.43 yds. × 7.43 yds.) by 10 m. 20 (33.5 ft.) in height above the bottom (— 7.5 ft.) of the basin.

This work forms part of the great programme of the British War Department for the laying out of the port of Richborough and the creation of three lines of ferry-boats between France and England for the needs of the war.

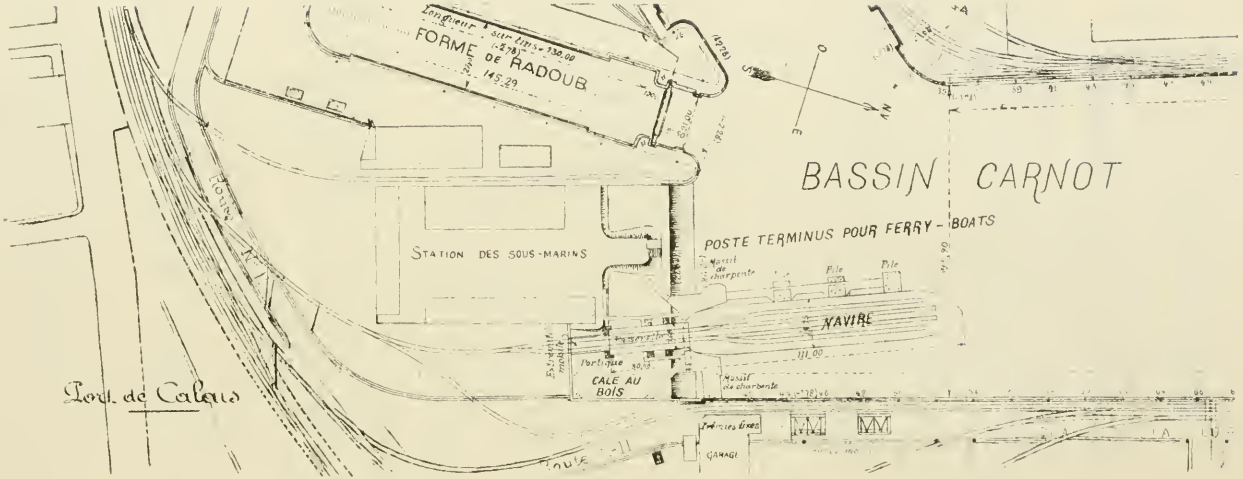
The terminus was constructed by the Port Construction Service of the British Army.

The cost was borne by the British Government for whom the use of this work is exclusively reserved. The results of the working are as follows:

In 1918, 279 trips with 190,326 tons of merchandise to France;

In 1919, 309 trips with 64,091 tons of merchandise to and 120,738 tons from France.

The works were begun on the 1st of July, 1917. They were finished in January, 1918.



Forme de radoub = Graving dock. — Longueur sur tins = 130.00 = Length on blocks = 142 yds.
Poste terminus pour ferry-boats = Terminus station for ferry-boats.

2° Completion of the work of deepening at the foot of the South-East quay of the « Ouest » floating dock.

The old quay wall with foundations at the level + 1 m. 92 (+ 6.28 ft.) has been demolished under water and the bottom of the dock dredged to the level — 2 m. (— 6.56 ft.) as far as the foot of the new quay wall built on sunken caissons behind the old one. The new quay offers a depth of 9 m. 20 (30.17 ft.) at high-tide and 7 m. 20 (23.6 ft.) at neap-tide on a length of 240 m. (262.4 yds.). A platform of about 20,000 m2 (21,420 sq. yds.) with an average width of 95 m. (104 yds.) has been metalled, and supplied with five railway tracks.

The works were executed under the supervision of Messrs. Voisin and Sanson, Ingénieurs en chef, at Boulogne-sur-Mer, Mr. Courtaigne, Ingénieur, and M. Delannoy, Sous-Ingénieur, at Calais, by Mr. Moine, Contractor for Public Works, 40, rue Dulong, Paris.

The total cost of the work is 1,615,200 francs. The cost is entirely borne by the Calais Chamber of Commerce, which paid into the Treasury funds an equal sum.

The increase in the traffic expected may reach from 150 to 200 thousand tons per annum, 40,000 tons of which will be wood from the North.

The amount of the expenses for the undertaking were fixed by contract at 1,151,535.95 francs. In reality it was 1 million 361,069 francs 03 cms., because:

a) The disposition of the platform, estimated at 80,000 francs, which was not included in the contract, was afterwards comprised;

b) The finishing of the works of 1916 to 1918 brought about a general revision of the prices with an average rise of 70 p. c.

The total cost has not however exceeded the original estimates, as the initial expenses had been largely calculated and it was possible to effect sundry economies, more especially by changing the nature of the materials for the metalling of the platform.

The works were commenced in the middle of 1912. Interrupted on the 4th of August, 1914, they were recommenced on the 1st of June, 1916. They were provisionally accepted on the 24th December, 1918.

(From information supplied in June 1920, by Mr. O. Courtaigne, *Ingénieur des Ponts et Chaussées, 2, place de l'Estran, Calais.)*

PORT OF DIEPPE

Construction of a new entrance and quays for the fishing industry.

(Act of the 24th December, 1903.)

The works for the new entrance were undertaken principally in the interests of the steamship Line Dieppe-Newhaven, worked by the French State and the London and Brighton Railways. Their object was to allow of the arrival and departure of the boats at fixed times, which required the maintenance of a channel dredged to 13 feet below the zero of the charts, hence the obligation to prolong the jetties as far as the natural bottoms of — 9.84 feet at least. The curve and the narrowness of the channel no longer being suitable for boats 90 m. (295 ft.) in length, it was also necessary to modify the position of the jetties.

The fishery quays have been built with the object of replacing the deep water quays of the fore port, formerly reserved for fishing-boats and, in 1895, given over to the Dieppe-Newhaven Line of steamers.

The works consisted of:

1° The prolongation of the « Ouest » jetty by a masonry jetty with foundations on the rocky chalk made of metallic caissons sunk by compressed air; the depth of the foundation varied from (— 4 m. 50 = — 14.76 ft.) for the first three caissons, to (— 10 m. = — 32.8 ft.) for the others. The prolongation measures 154 m. 21 (168.65 yds.) in length laid out in two straight sections, one of 55 m. 71 (61 yds.) making an angle of 139°47'30" with the old « Ouest » jetty, the edge of 98 m. 50 (107.65 yds.) making an angle of 144°21'30" with this same jetty;

2° The construction of a new jetty to the East, in masonry with similar foundations to the above at the average level (— 4 m. 50 = — 14.76 ft.), laid out along three straight lines the last of which ends at a timber jetty-head 15 m. 50 (17 yds.) long and 109 yds. distant form the new West jetty-head. The total length of the new East jetty is 556 yds. The surface enclosed between the two new jetties is 11 hectares (26 1/2 acres);

3° The demolition of the old East jetty and the breakwater attached to it:

4° The dredging of the new channel to — 4 m. (— 13.12 ft.), and of the zone comprised between the two new jetties to — 3 m. (— 9.84 ft.);

5° The construction of quays with foundations on compressed air caissons at the level — 4 m. (— 13.12 ft.) along the South face of the fore-port for a length of 170 m. 30 (186 yds.);

6° The construction of a quay with foundations on compressed air caissons at the level — 2 m. 50 (— 8.2 ft.) along the East face of the fishery dock for a length of 102 m. 12 (111 1/2 yds.).

The plans were drawn up by Mr. Herzog, Ingénieur ordinaire, at Dieppe, under the direction of Mr. Lechalas, Ingénieur en chef, at Rouen.

The execution of the works was under the supervision of Mr. Lechalas and, towards the end, Mr. Cléry, Ingénieur en chef, Messrs. Herzog, Benezit and Genet, Ingénieurs ordinaires.

The works executed gave rise to a total outlay of 8 million 620,492 franc, entirely borne by the State, the department of the Seine-Inférieure, the town of Dieppe and the Dieppe Chamber of Commerce, as follows:

The State ....fr.	3,841,105
Department	650,000
Chamber of Commerce	4,092,250
Town of Dieppe	37,137

In the sum of 8,620,492 francs, mentioned above, the construction of a beach to the South of the zone between the jetties is not included, this was provided for in the project, but its construction was put off and withdrawn from the undertaking, it is now the object of a special project.

It is difficult to give figures as regards the financial results of the work, the steamship service, in whose interest it was chiefly undertaken, having been suspended during the war.

In any case the commercial traffic has risen from 500,000 tons in 1914 to 1,300,000 tons in 1918 and the improvement of the entrance is one of the principal causes of this.

The fleet of fishing boats, at Dieppe, has also increased from 18 steam-trawlers in 1914, to 38 in 1920.

The original plan only provided for the dredging of the canal to the level — 3 m. (— 9.8 ft.); this was however recognised as

being insufficient for the steamers, their draught being more than 3 m., and it was increased to — 4 m. (— 13.12 ft.).

The walls of the South quay of the outer harbour were to have their foundations at the level — 2 m. 50 (— 8.2 ft.); this level was increased to — 4 m. (— 13.12 ft.) so as to allow of maintaining at the foot a dredged bed at the level — 3 m. (— 9.8 ft.), which is necessary for the trawlers drawing more than 4 m. (13.12 ft.) and which put to sea at almost any state of the tide.

During the work on the new West jetty, it was found that the level of the foundations provided for at — 4 m. 50 (— 14.7 ft.) did not correspond with the rocky chalk, but with a not very compact mass of marl, clay and decomposed chalk and it was necessary to modify the depth of the foundations which were placed at about — 10 m. (— 32.8 ft.) in the compact chalk. Advantage was taken of this to modify the width of the entrance which was increased from 90 m. (98 yds.) to 100 m. (109 yds.), a width slightly superior to the length of the largest steamers; the lower extremity of the West jetty, for a length of 98 m. 50 (107.6 yds.), was thus carried a little towards the North-East; at the top of the break thus formed, a masonry counterfort was placed built on a caisson 16 m. (17.5 yds.) long by 4 m. 70 5.1 yds.) wide. Lastly in order to take into account the increase in the height of the jetty resulting from the deepening of the foundations, all the successive sections (built on caissons not joined but linked together by arches) were made dependent on each other by means of continuous horizontal and vertical rails embedded in the masonry work.

(*From information supplied, in June, 1920, by* Mr. Cléry, *Ingénieur en chef des Ponts et Chaussées, 2, rue Duguay-Trouin, Rouen.*)

PORT OF HONFLEUR

Construction of a new quay with platforms at the Carnot dock

(See plan herewith.)

The object of this work is to provide wharves for unloading coal. The new quay will be 181 m. (196 yds.) long with a draught of 7 m. 50 (24.5 ft.) and platform behind 65 m. (70.5 yds.) wide.

The original estimate, according to the initial scheme, amounted to 840,000 francs, 630,000 francs of which had to be paid by the Chamber of Commerce.

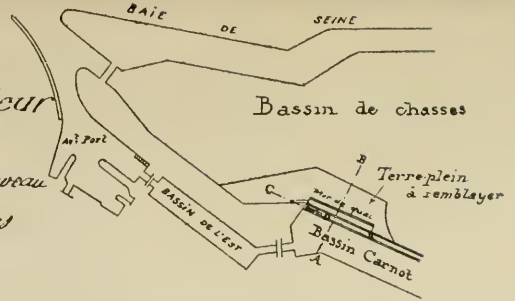
The actual estimate is 1,700,000 francs.

(From information supplied, in May, 1920, by Mr. Vasseur, *Ingénieur en chef des Ponts et Chaussées, Caen.)*

Translation of French terms :

Profil transversal des terrassements et dragages suivant AB = Cross section of earthwork and dredging on AB. — Bassin = Dock. — Terre-plein à remblayer = Platform to be filled in. — Perré à pierres sèches à démonter = Stone packing to be taken away. — Rideau de palplanches métalliques à enlever = Screen of metal sheet piling to be taken away. — Niveau déterminant la classification des déblais = Level determining the classification of the excavations. — Remblai = Filling. — Déblais = Excavations. — Zéro des cartes marines = Zero of Charts. —Digue d'enceinte du terre-plein = Dike enclosing platform.

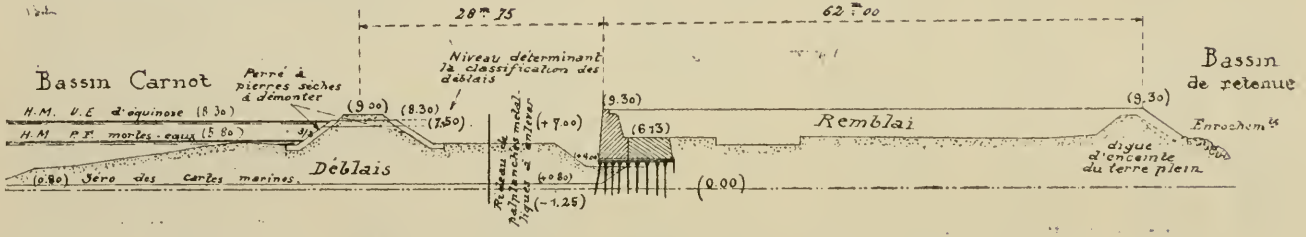
Plan.



Port de Honfleur

Construction d'un nouveau quai avec terre-pleins

Profil transversal des terrassements et dragages suivant A B



Perré Ouest Coupe suivt C.D

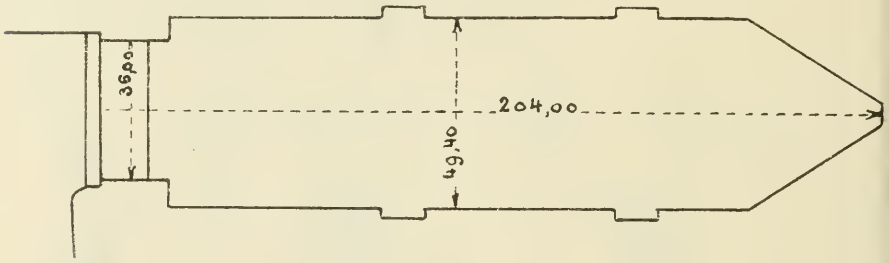
LORIENT (Naval harbour)

1° *Graving dock n° 3*, approved definitely in 1912, built by Messrs. J. and G. Hersent under contract of the 11th November, 1912.

This dock is for large battle-ships.

The length between the rabbet of the support of the gate and the foot of the back wall, according to the original plan was 196 m. 31 (214.5 yds.). During the work this was increased to 204 m. (222.5 yds.).

The lengthening to 250 m. (269 yds.) has been taken into consideration; no absolute decision has yet been taken.



Width between vertical walls of gates, 36 m. (39.3 yds.).

Height of coping at entrance +7 m. 70 (+25 ft.), at the end +8 m. 30 (+27.8 ft.).

Level of sill — 7 m. (— 22.97 ft.).

Level of bottom — 8 m. 40 (— 27.5 ft.).

The original detailed estimate was 4,810,822 francs.

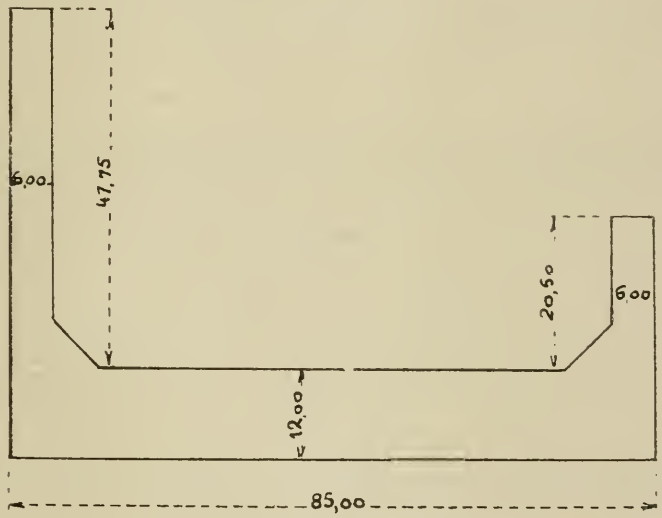
Interrupted at the commencement of the hostilities, the works were continued at the beginning of 1917 and finished in 1921.

After declaration of the right to cancel, the enterprise was the object, the 16th November, 1916, of an additional clause of which the essential principle is that the prices of the primitive account-sheets are maintained, the Navy taking into account the increases, resulting from the state of war, with the contractors.

The cost is naturally borne by the Naval estimates. No receipts are assumed, the Navy only accidentally receiving merchant ships in the arsenal docks.

2° A *reinforced concrete wharf* on the left bank of the Scorff, built by Messrs. Bolo and Sedilleau, Contractors at Nantes, having as consulting engineer Mr. Rabut, Inspecteur Général, the author of the scheme. The construction was definitely decided on in 1918. The contract made on the 15th November, 1918.

The wharf is destined for the completion afloat of cargo-boats built at Lorient by the Navy. ,



It consists of a principal structure connected with the bank by two gangways.

Principal structure, length 85 m. (92.8 yds.), width 12 m. (13 yds.).

Gangways, length 47 m. 75 (52.16 yds.) and 20 m. 50 (22.4 yds.) ; width 6 m. (6.56 yds.).

Level at top +7 m. 50 (+24.5 ft.).

Level at bottom dredged at the foot of the work — 5 m (— 16.4 ft.).

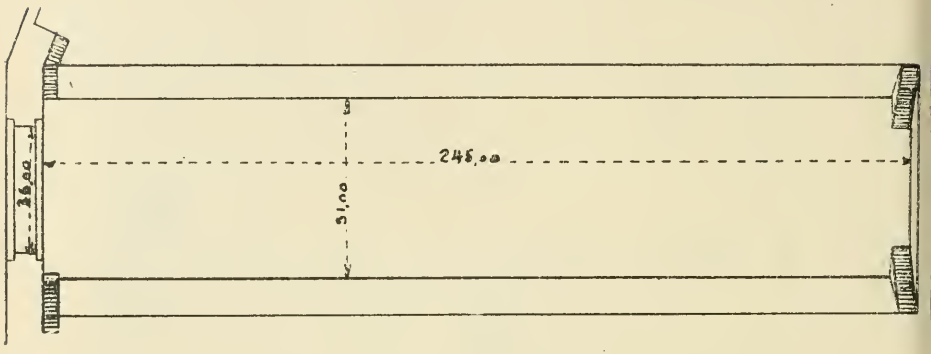
The wharf which will be supplied with a travelling 2 1/2 ton crane, with a range of 16 m. 60 (54.4 ft.) measured from the axis, and of a total weight of 38 tons, in working order, offers this particularity that it is entirely built of slag concrete.

The original detailed estimate was 630,000 francs, the cement on the spot being reckoned at 120 francs and the iron bars at

90 francs, the difference between the above prices and the real prices being paid for by the Navy or to the latter.

After declaration of the right to cancel, an additional clause of the 26th December, 1919, comprising besides some modifications as regards details, granted to the contractors an increase of 30 p. c. on the work executed on and after the 16th of July, 1919.

The contract work is finished; a few works of completion (by the Naval Administration), fenders, berths, etc., remain to be done.



The deficiency, not yet paid, will amount to about 870,000 francs.

The expense is entirely borne by the Navy.

3° A *covered construction dock* on the site of the « Fosse aux mats », definitely approved in 1913.

This is a construction dock for the large naval units the length of which (for future units) would render launching, after building on slips, practically impossible by reason of the narrowness of the Scorff.

This dock, situated on the left bank of that river, is finished as far as the masonry work is concerned; the roof is being placed at the present time under the direction of the Naval constructions engineers.

The length is 245 m. (267.9 yds.); width at the level of the lower floor 51 m. (55.7 yds.); on the large sides the dock has stepping at a slope of 45° and at the end a wall with a batter 1/10.

The lock, at the vertical walls, is 36 m. (39.3 yds.) wide.

The sill is at the level — 1 m. (— 3.28 ft.), the bottom at the level — 2 m. (— 6.56 ft.).

The pumping station is located in the Northern block of the lock.

The only special difficulties met with were on account of the lightness of the caisson of the lock.

a) From the beginning of the sinking, at the Southern extremity, of the large caisson, very hard rocky soil was encountered, the Northern part, on the contrary, only encountered solid earth at about the level — 10 m. 50 (— 34 ft.). The deteriorations suffered by the caisson in its Southern part during its descent of more than 32 feet in pure rock, caused the stoppage of the sinking while the Northern part was still at some distance from the foundation. It was necessary to finish the foundation by descending to a fairly considerable depth (more than 6 1/2 feet on a rather extended surface) below the cutting-edges.

This very delicate and even rather perilous work was well carried out.

b) During the finishing of the floor and of the front floor under cover of the blocks of the caisson sustained by a metal framework this latter broke. The work on the floor which was nearly finished was completed with difficulty under cover of a not very high coffer-dam, behind which at low tides the water was drained off.

This thankless work was very long though of little importance.

The final deficiency for the covered dock amounts to about 3,500,000 francs.

It has only been accepted under protest by the contractors; the matter has not yet been settled.

The cost is entirely borne by the Navy.

The original detailed estimate amounted to 2,229,229 francs.

Two additional clauses were added successively after declaration of the right to cancel.

The first, dated June 8th, 1916, applicable to the works executed on and after the 15th of May, 1915, agreed to an increase of 39 to 40 p. c. on the amount of the works then remaining to be executed.

The second, dated March 20th, 1919, applicable from the 1st of February 1918, stipulated an increase of 60 p. c. on the prices resulting from the preceding one.

Thus, as we have already said, the final deficiency, only accepted under protest, amounts to 3,500,000 francs in round figures.

The dock should have been filled, originally, solely by tunnels in the gate which was executed under the direction of the Naval Constructions Engineers.

In the course of execution, at the request of this service, which would be the commoner of the dock, it was successively decided to create two aqueducts for the filling, one to the North, the other to the South of the lock.

The building of the former was entrusted to the contractors for the dock.

The second was executed by the Administration after the contract work was terminated.

Besides these modifications of the original scheme there were only a few of no great technical interest.

The works were commenced in the month of August, 1913.

There was a slackening (and even at a given moment almost complete stoppage) of them during the war.

They were provisionally accepted on the 23rd September, 1919.

4° *Landing stage and sheds called « de la Roumanie »* on the left bank of the Scorff (work decided on the 31st of December, 1916, with a view to storing and embarking ammunition and materials for Roumania).

The landing stage is composed of a principal structure 76 m. 50 by 7 m. (83.6 yds. × 7.65 yds.) joined to the bank by two gangways 27 m. 70 (30.3 yds.) and 26 m. 70 (29.2 yds.) long and 4 m. (4.37 yds.) wide.

The sheds, 4 in number, were 50, 50, 60 and 60 m. long and of a uniform width of 16 m.

They were simply covered, the framework was made of wood, the roof of slates.

Neither the stage nor the sheds were used for the purpose in view when they were built.

The South end of the landing stage has been strengthened to receive a 2 ton crane and has been placed at the disposal of the port.

The sheds were put to widely diffrent uses, three were enclosed with slag concrete and installed for lodging prisoners of war and Bulgarian workmen ; two of these three have been transformed since the war into a gymnasium for the battallion of fusiliers.

The landing stage cost ... ... fr.	127,400
and the sheds	112,600

The cost, at first put down to war expenses, will probably be repaid by the Navy, which alone makes use of these works.

The execution, ordered the 31st of December, 1916, was finished at the end of April, 1917, for the sheds, and at the end of July, 1917, for the stage.

5° *Slip for launching large hydroplanes* for the high seas (work approved the 1st of August, 1917, and performed by the Government). (It was completed by four large sheds destined to shelter the hydroplanes; as these four sheds cannot be considered as maritime works, they are only mentioned as a reminder.)

The slip is 125 m. (136 yds.) long by 7 m. 50 (8.2 yds.) wide.

It is entirely of wood. It starts at the level + 21.3 ft. and finishes in the water at — 1.37 ft.

Completed in October, 1918, that is to say shortly before the armistice, the slip was not used during the war for launching large hydroplanes, which, besides, had not arrived and the sheds for same were not finished when hostilities ceased.

(The launching of ordinary hydroplanes was performed until the end of the war by means of an old foot bridge widened and extended towards the water by an inclined plane the end of which rested on a floating stage.)

The expenses amounted to about 110,000 frs., they were borne by the Navy.

Originally designed with a width of 9.8 ft. and for a weight of 7 1/2 tons, the slip was finally destined for hydroplanes of nearly 15 tons. The framework which had not been begun was strengthened in consequence and the width increased to 24 1/2 ft.

The slip was ordered on the 1st of August, 1914. By reason of the inadmissible pretentions of the only contractor who gave an estimate for a reinforced concrete slip, this idea was given up, and it was decided to built one in wood.

Delayed by the great difficulty there was in obtaining piles 18 m. (59 ft.) long, which were necessary, the slip was only finished in October, 1918.

(From information supplied, in August, 1920, by M. DE LARMINAT, *Inspecteur Général des Ponts et Chaussées, Directeur des Travaux Hydrauliques, at Lorient.)*

Bibliography : Works connected with Ocean and Inland Navigation, 1913, page 125.

FISHING PORT OF LORIENT

The Merchant Marine Commissariat has considered the founding of three or four ports specially constructed for the fishing industry and similar to the large foreign ports of this kind, the most important of which are to be found in England: Grimsby, Hull, Aberdeen, etc.; in Germany: Gestmunde; in Holland : IJmuiden.

These ports will be.

For the North Sea and the English Channel, Boulogne, which is already doing a considerable trade in fish, but was not specially constructed for fishing craft of modern build, as are the ports of foreign countries;

On the Mediterranean: Cette or Port-de-Bouc;

On the Atlantic: Lorient and La Rochelle.

1st *Reasons which justify the construction of a fishing port at Lorient.*

The situation of Lorient is doubtless the most favourable for fishing on the Atlantic.

First of all, from a geographical point of view, because being situated near the Breton headland of the coast of Europe, it commands a considerable extent of the sea including the fishing grounds which are among the richest and are the least fished. these fishing-banks stretch from the Bay of Biscay to Ireland, gradually increasing the distance as far as 350 miles from the mouth of the English Channel. They cover an area of nearly 500,000 square kilometres, which is equal to the North Sea, the latter being, since a long time, the most fructuous of the European deep-sea fishings and can occupy a fleet of 2,000 steam fishing trawlers.

From the point of view of the facility of carrying on all sorts of fishings and to find a fishing population sufficient to do it:

A fishing port only lives under difficulties if it is absolutely specialized for one sort of fishing, it prospers only where the greatest number of fishings of different kinds can be pursued.

Now, from Lorient, deep sea fishing for common or fine fresh fish can be done by fishing smacks or trawlers; deep sea fishing

is especially for the tunny; the fishing inshore is for makerel, sardines, sprats and shell-fish. Lorient is very well situated for cod fishing either on the banks of Newfoundland, Iceland or Morocco. Lastly, oyster culture is flourishing in Brittany. The two great centres of natural production of the flat native oyster (*ostrea edulis*) are for France the oyster beds of Auray and Arcachon.

The district of Lorient is already an important centre for fishermen and fishing boats, as the following figures will show:

Over the whole of the Atlantic, France has a fleet of 100,000 tons. From the point of the Raz to the mouth of the Loire, the concentration of this fleet is now larger than elsewhere, since it counts 5,000 fishing boats of 45,000 tons, i. e. nearly half of the whole fleet. In the Lorient district and the Island of Groix, that is to say over a distance of 15 to 20 kilometres as the crow flies, 1,360 boats of 24,434 tons are assembled, i. e. almost a quarter of the whole Atlantic fleet, and it must be particularly remarked that the boats of the districts of Lorient and Groix are generally of a heavier tonnage and better equipped for fishing than are the average boats of the Bay of Biscay. This is the reason that from Brest to the Spanish frontier there are only 500 sail-boats having a tonnage of over 50 tons, and of these the district of Lorient alone can count more than 300.

From a nautical point of view, the situation of the harbour of Lorient is exceptional, in that it affords a safe shelter and anchorage to vessels.

This favourable situation of Lorient explains that although almost no work has been done for the development of the fishing, it has considerably increased: in 1903 1,200,000 kilos of fish were landed, in 1913 the catch was over 10 million kilos (10,000 tons).

It is therefore quite justifiable to expect that Lorient will become the largest fishing port of the Atlantic, and probably the most prosperous in France.

2nd *Conditions which a large fishing port must fulfil.*

Before looking into the solution which has been adopted in the adjoining project, it is advisable to stipulate the conditions to which a large modern port must conform as it is on these

conditions that a site for the port must be chosen and a project appreciated.

A port consists of a *water surface* and a *land surface*. Let us, first of all, examine the water surface. The ports Ijmuiden and Gestmunde have superficial areas of about 15 acres of water. The second of these ports is frequented by about 150 steamers and 400 sailing vessels. The port of Grimsby, which is the largest in the world, has a water surface of about 28 acres to accomodate a fleet of steam fishing smacks having a tonnage the double of all the French smacks put together. The quantity of fish landed annually reaches 230,000 tons, almost equivalent to the total production of France. It is true that its enlargement by making a new basin of about 30 acres is under consideration.

At Aberdeen the water surface is about 20 acres; at Hull, 18 acres. So, in these ports the traffic in fresh fish is very important (IJmuiden, 52,000 tons; Gestmunde, 47,000 tons; Hull, 100,000 tons; Aberdeen, 100,000 tons).

It appears, therefore, that a basin of 20 acres would be amply sufficient at Lorient. This surface of water is surrounded by quays, which, like the foreign ports we have quoted as models, ought to be specially equipped.

Some of the quays will be prepared exclusively for the unloading, the sale and the packing of the fish in boxes or baskets, which have been bought by the fish-factors. That requires a covered or roofed sale-hall running all along the quay and opening on the quay side, the other side opening on a *building which is let in sections to the fish-buyers* and alongside the railway line. This is the plan adopted in the latest fishing port constructed in Germany: Cuxhaven.

Its is possibe, with appropriate means of unloading (small electric cranes like those employed at Cuxhaven and at Gestmunde) that each berth would serve, at least, twice a day for the unloading of fish. If we reflect that the duration of the voyage of a smack is, on an average, eight days, we ascertain that we must consequently count the length of one boat (130 to 155 feet, about) for 16 boats, or 6 feet 10 inches to 8 feet 3 inches of quay per boat. But the arrivals are not equally divided over the days of the week, it would, therefore, be advisable to allow 16 feet 6 inches per boat.

Another part of the quays must be equipped for the loading of coal for steam fishing boats and of ice. It would be at most equal to the first part, because the loading of coal, with the right appliances, could be done more rapidly than the unloading of fish. At Gestmunde, the relation in length between the coal quay and the fish landing quay is about 2/3; at Cuxhaven it is 1/2; at IJmuiden it is still less.

We may therefore, count *a total of 8 running metres or 26 feet per steamboat* attached to the port.

For the sail or motor boats of the tunny fishing kinds, the calculation is more uncertain because we are less certain of the duration of the rotation; it would be advisable to count on about 6 ft. 6 in. to about 10 ft. per sail boat of 66 ft. in length.

For a total of 50 steam boats and 200 large sail or motor boats, we may estimate the length of quays at about 900 m. (984 yds.). If the number of steam boats amounts to 100, 1300 m. (1420 yds.) would be required. About 550 yds. must be added for small sailing boats, making a total of *1800 m. (1970 yds.) of quays.*

This is what appears necessary at once, and it is a figure that it must be possible to increase in the future.

By way of comparison, the length of the quays are at IJmuiden, 1,300 m. (1,420 yds.); Gestmunde, 1,800 m. (1,970 yds.); Grimsby, 2,230 m. (2,438 yds.); Aberdeen, 1,500 m. (1,640 yds.).

As to the depth of the port, it must be such as to allow boats to enter the port at almost any state of the tide; a wait of a few hours might cause a delay of a whole day before the fish could arrive *on the markets of the interior of the country.*

The trawlers, when loaded draw 3 m. 60 to 4 m. 50 of water (11.7 ft. to 14.7 ft.) some fishing boats draw 4 m. 75 and 5 m., but they are very rare. The large sail-boats or the « Dundee » motor boats draw 3 m. 20 (10.5 ft.) at most.

It is sufficient to have, in the port, for the first, a surface whose bottom is 5 m. (16 1/2 ft.) under Spring tides at low water, i. e. for Lorient at 4 m. (13 ft.) below zero of the charts, and for the second a surface whose bottom is 3 m. (9 ft. 9 in.) below zero. These depths are at least equal to those of the for-

eign ports already quoted. It would be very difficult to obtain them at other ports than Lorient in France.

The largest trawlers having a length of 50 m. (164 ft.) and being obliged to avoid, between the quays, other boats whose beam is 6 m. (28 ft.), we may admit 70 to 80 m. (76 1/2 yds. to 87 1/2 yds.) as the minimum width at the narrowest parts.

On summing up we come to the following results as to the characteristics of the water parts:

Water surface about 8 hectares (about 20 acres). Length of quay: 1,800 m. about (1,972 yds. about). Depth: 5 m. (16.4 ft.) and 4 m. (13 ft.) below low water of Spring tides. Minimum width 70 to 80 m. (76 1/2 to 87 1/2 yds.).

Lastly, we must count on the construction of the large cold rooms (refrigorators) of the State, now in course of construction for the importation of frozen fish. It is indispensable to be able to receive cargo-boats carrying from 3 to 4,000 tons of frozen fish whose draught will be 6 to 7 m. (19 1/2 ft. to 23 ft.). It is, therefore, necessary to have a quay with this depth at low water. This quay also capable of receiving English coal to supply steam fishing boats, will be placed near the quay for unloading colliers.

A port is not composed only of surfaces of water bordered by quays, behind these large sites are necessary that will serve:

To build sale-rooms and store-rooms to be let to the fish factors.

To construct railways with a station, having a sufficient number of sidings and shunting lines.

For all industries connected with fishing, yards for building and repairing boats, net making factory, artificial ice factory, box making shop, preserved or tinned fish works, curing yards, industrial or medical oil factories, works for transforming the offal of fish into manure or flour for feeding fowls or pigs, etc.

It is, naturally, rather difficult to estimate how much land is necessary for a large fishing port. That varies according to the place, but, however, *the land area is always several times larger than the water area.*

At Gestmunde there is 8 hectares (20 acres) of water for 64 hectares (160 acres) of land. It is true, that they have provided amply for future developments. At Grimsby, a port constructed

by the Great Central Railway Company, this Company alone reserved for its railroads and installations of all sorts 35 hectares (88 acres) and they now foresee an increase of about 22 hect. (about 55 acres).

For a port like that of Lorient, it is estimated that it is advisable to have about 40 hectares (about 100 acres).

As can be seen farther on, when we deduct the area of land necessary for salerooms, curers' stores, the spaces reserved for the circulation of the public, roads and railways, there will remain little more than the half to be occupied by the works and manufactories.

But we must think of lodgings for the seamen and labourers. A large fishing port that will occupy about 100 steam fishing boats and 200 large sail boats should have a population of 8 to 10,000 souls, whose dwellings, situated in the immediate neighbourhood of the fishing-port, will occupy at least about 50 hectares (about 125 acres).

In almost all foreign ports the fishermen's houses soon rise in groups around the port and this grouping has not caused one of the least difficulties to solve where the ports had been constructed without a reserve of land in the neighbourhood.

In short, to construct a fishing port, we must have, at our disposal, for the port itself, about fifty hectares (125 acres), of which, about 8 h. of water, the remainder of land, for factories, workshops and dwellings, and an area of the same size situated as far as possible in the immediate neighbourhood of the port.

It is an indispensable condition to realize in the choice of the site of a fishing port, that the port should be quite separate and distinct from the neighbouring commercial ports.

A fishing port is not an ordinary commercial port in which fishing craft come as other ships do and are, like them, without any private rights.

The absolute specialization of the quays and the organization of the management, requires that the port be set apart exclusively for fishing. It is the same for the rules that govern the working of the port: for the commercial ports, the merits and inconveniences of autonomy ought to be discussed; for a fishing port it is indispensable and must be as complete as possible.

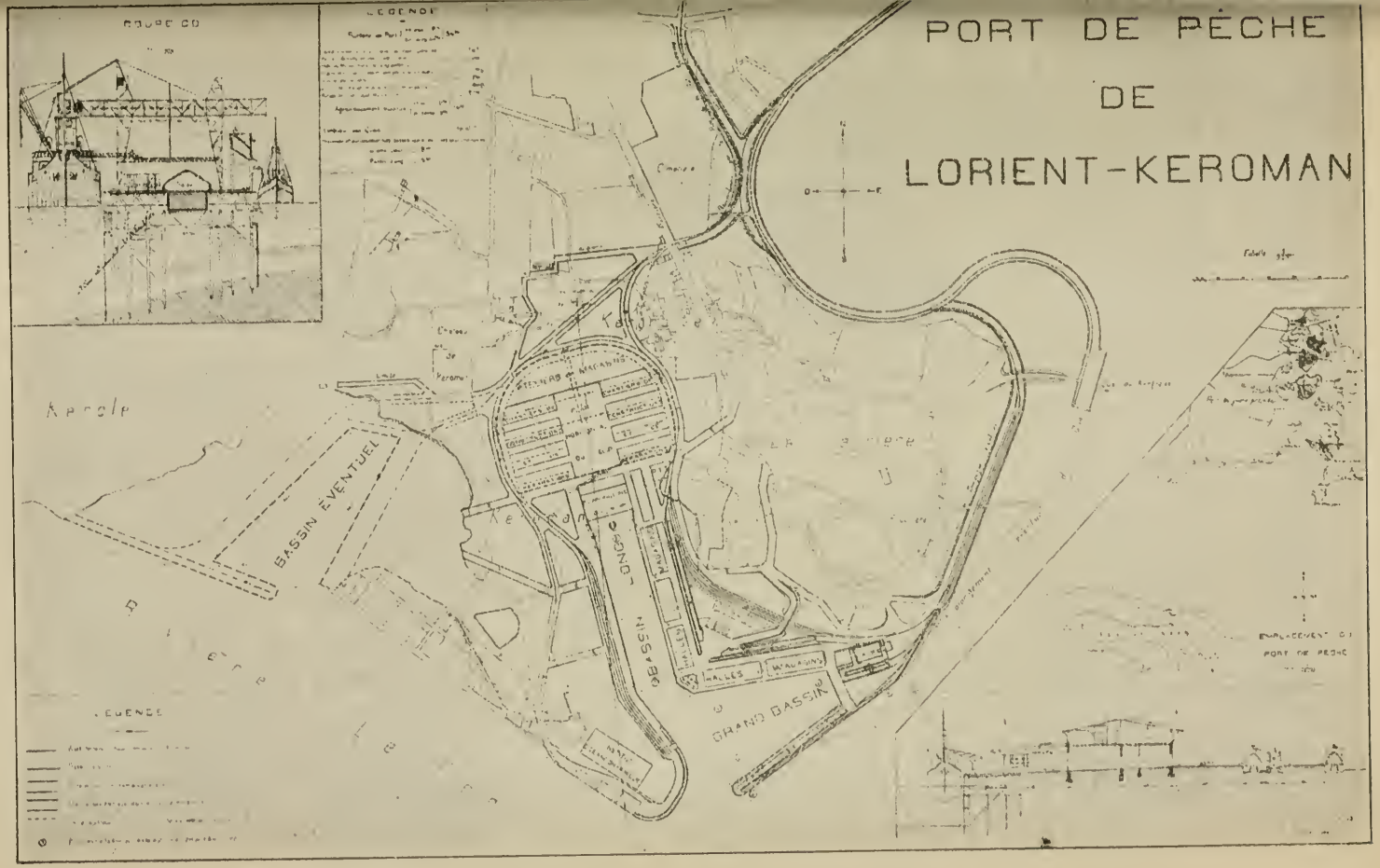


Fig. 1. — Fishing port of Lorient-Keroman.

All the authors who have written on the question of ports are of this opinion.

Mr. Poher, in his interesting article on the German ports says: « The three fishing ports are quite independent of the neighbouring commercial ports, which appears to be the first condition of a rational organization », and Mr. Kerzoncuff, the Manager of the Fishing service, whose competence in this matter is indisputable, says, in his fine book on sea fishing:

« It is necessary that the fishing port be entirely independent of any commercial port, and that, if both exist in the same place, the docks that form the fishing port should have their own life, their equipment, in short, their entire autonomy » (1).

The examples drawn from foreign countries justify these considerations. Everywhere they want to construct a real modern fishing port, they have come to the conclusion that the fishing port and the commercial port must be distinctly apart and separate from each other.

In Germany, Gestmünde fishing port, was at first Gestmünde commercial port, on the Weser, but the two ports are distinctly apart, their rules and management are absolutely different. The same can be said of Cuxhaven. In England, Grimsby has a commercial port, but its fishing port has two docks having their private entrances on the river Humber; the situation is analogous at Hull and at Aberdeen.

In short, the absolute specialization of a fishing port is an absolute law: it is only cargo ships that carry the necessary material for fishing, coal especially, that can have access to the fishing port.

It was the Keroman creek that was adopted for the site of the new port.

3° *Description of the Lorient-Keroman fishing port.*

The port, turned towards the S.S.E., i. e. towards the open sea, is a tidal port without locks. This is the best solution for a fishing port, as any loss of time involves a considerable loss of money.

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(1) The same thesis is upheld by Mr. Hart in his report of the *5th Congress on Sea fishing*. « Even if the fishing port is side by side with a commercial port, its management must be completely separate from that of the latter port. »

It is formed of two works. (See plan n° 1.)

One of the *Eastern mole* quay, which is 27 m (29.5 yds.) wide, is accessible on the outside for 350 m. (380 yds.) to ships drawing 7 m. (22.9 ft.) of water and on the inside for

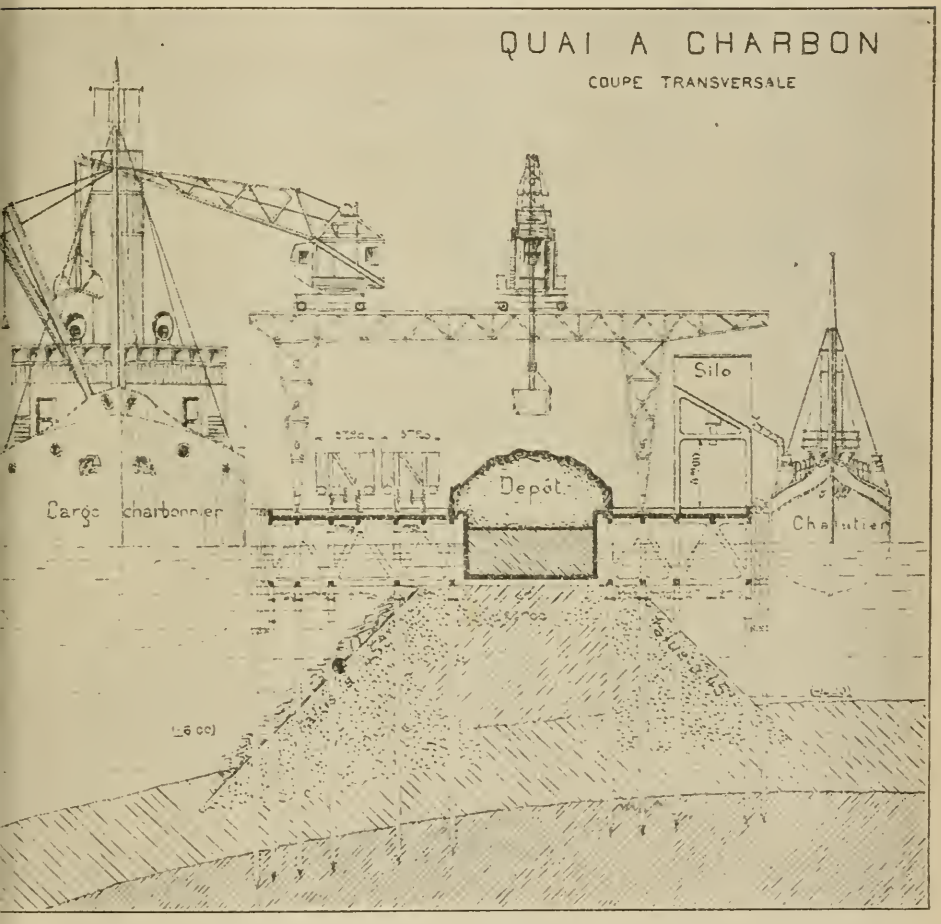


Fig. 2 — Coal wharf.

250 m. (273 yds.) to trawlers. It *will play the part* defined above, *of coal wharf* and will be arranged accordingly. Two railway lines and some coal carriers will be placed on it, in the centre a place will be reserved for the coal store, on the inner side, some pits that will contain as much as the average sized

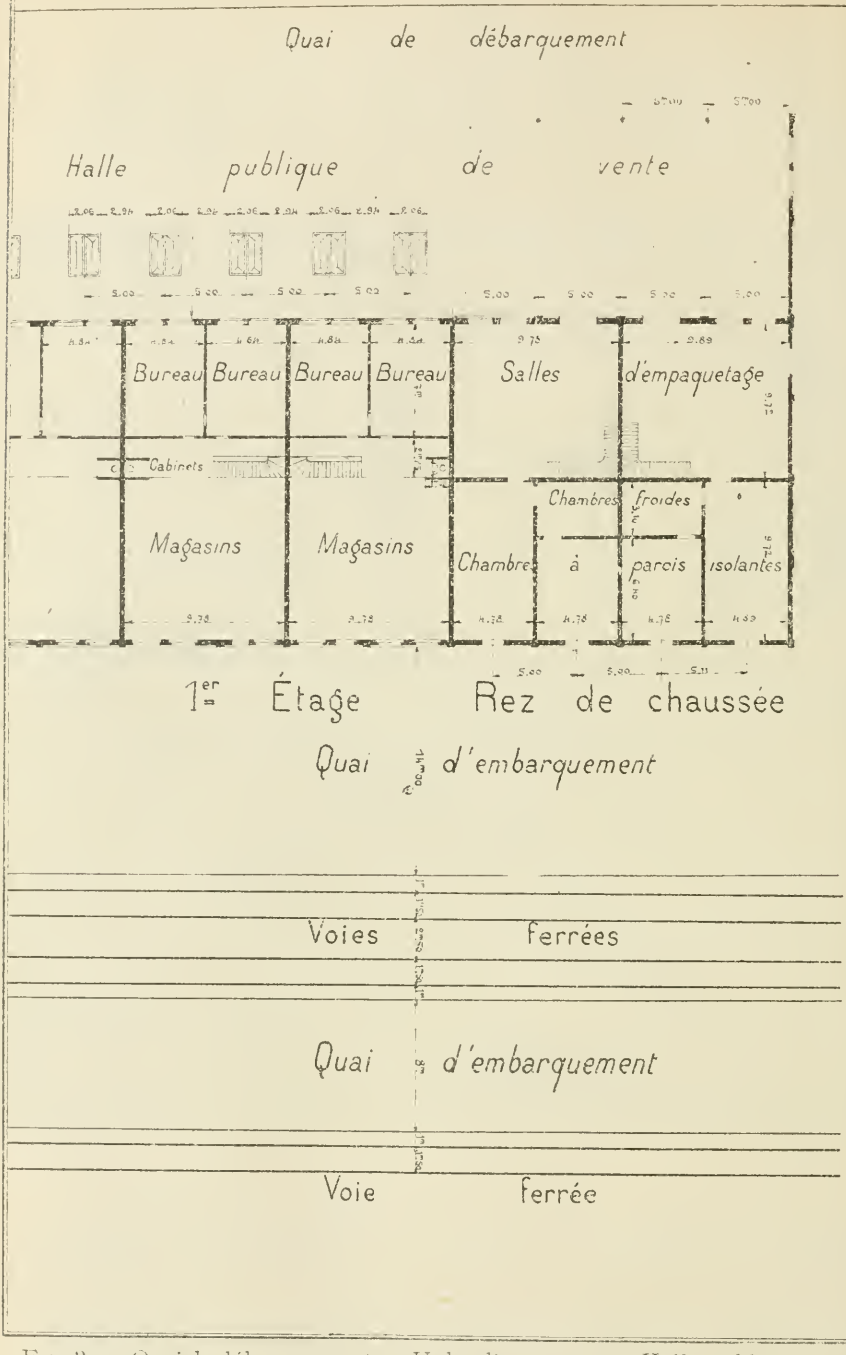


Fig. 3. — Quai de débarquement = Unloading quay. — Halle publique de vente = Public sale-room. — Bureau = Office. — Salles d'empaquetage = Packing rooms. — Magasins = Stores. = Chambres froides = Cold stores. — Chambres à parois isolantes = Stores with insulated walls. — Ier étage = Ist floor. — Rez-de-chaussée = Ground floor. — Voies ferrées = Tracks. — Quai d'embarquement = Loading platform.

trawler takes will be spaced at intervals of the average length of one of these boats.

Normally, a collier will be unloaded either on to wagons for the consumption of the works of the port, or discharged into the pits for the supply of fishing boats.

It is only temporarily that storage is anticipated, it being understood that when the pits are empty, if the ship has left, coal is taken from the store to fill the pits. Under these conditions the filling of the coal bunkers of a trawler is accomplished with the greatest rapidity possible.

We shall touch again, farther on, on the use of 100 m. (109 yds.) of quay in the North section.

The other work enclosing the port, *southwest mole*, will be economically established on a rocky plateau, prolonging the entrance of the river Ter. The passage between the two moles will be 90 m. wide (98 yds.)

The *first* dock, named « grand bassin », is destined for ships that draw the greatest depth of water (as well as the south part of the long dock) *includes at the East side a quay 70 m. (76 1/2 yds.) long and at the North side one of 250 m. for the discharging of fish and sale of same.*

This quay is lined with sheds and stores constructed in imitation of those of Cuxhaven. The public sale room which is 12 m. wide (13 yds. 4 in.) is separated from the quay by an interval of only 7 m. for there is, in principle, no circulation of vehicles along this way. Only the « devils », or better electric cars, run along or across the quays carrying boxes of fish to the sheds or sale rooms.

The sale of fish will be assured by the management of the port, on payment of a very low tax, in proportion to the value of the fish sold (in France, the taxes of this kind are much too high : they vary from 5 to 8 p. c. about; at IJmuiden, they are 2 p. c.; at Hamburg, 3 p. c.; at Cuxhaven, 2 p. c., at the latter port the tax has been considerably reduced).

The hall of which one side faces the quays, opens on the other side, on the stores which are let to the fish factors, and are provided with light, water, heating and even the distribution of cold air.

The fish factor puts the fish bought into his store, arranges

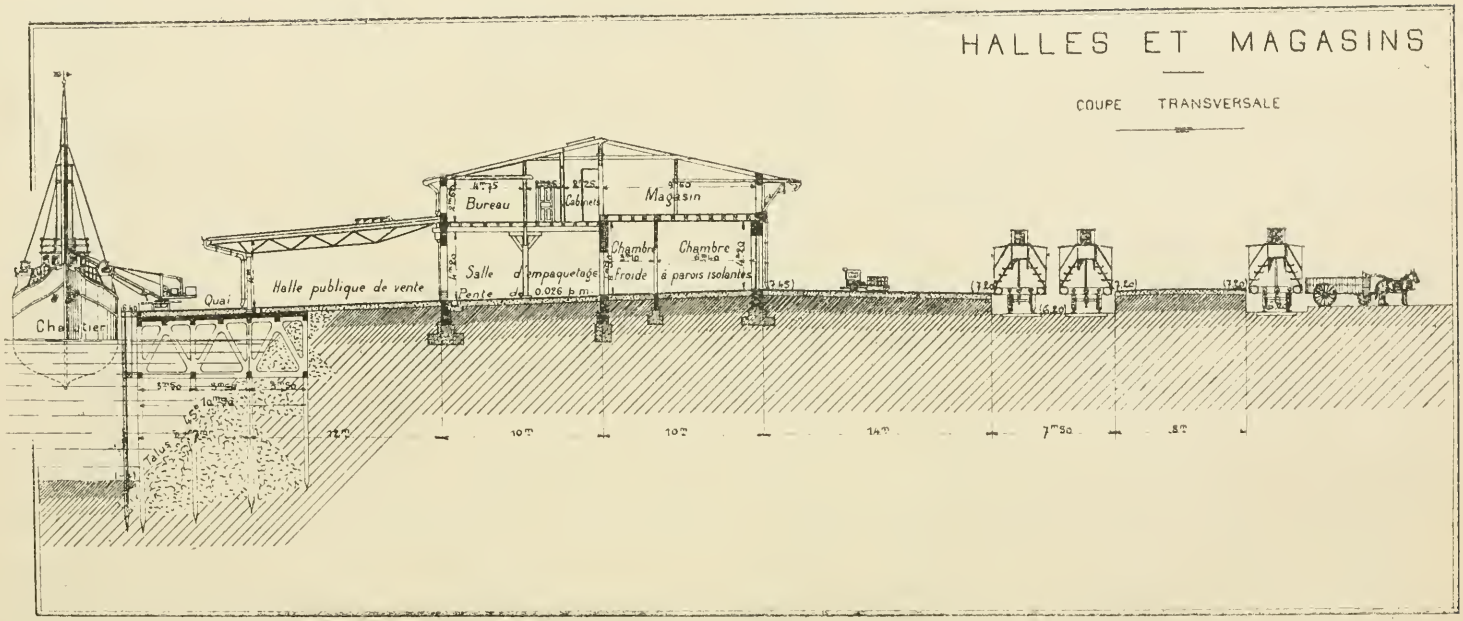

HALLES ET MAGASINS
COUPE TRANSVERSALE
Chantier
Quai
Halle publique de vente
Bureau
Cabinets
Magasin
Salle d'empaquetage
Pente de 0.026 p.m.
Chambre froide
Chambre à parois isolantes
22m
10m
10m
14m
7m50
8m

Fig. 4

the packages to be sent off, and puts them outside his door where a carrier, who is accepted by the railway Co. and by the port, takes them away to load them on wagons on the three railway lines situated behind the stores. These lines allow of the formation of trains simultaneously.

We must stop a moment at the very great importance there is for the development of a large fishing port, to attract the attention of fishbuyers. The more numerous they are the more active the business, the more one is free from the risk of underselling, the more rapid is the evalution and the more the place of fish as an article of diet becomes important.

The function of the fish factors, combined with a good organisation of the public sales, is so important, that in foreign countries the companies organised for the sale direct to the consumers, such as, for instance, the very powerful Company « Nordsee » of Nordenham, have, at least partially, recourse to public sales to which the fish factors come in numbers.

At IJmuiden and at Gestmunde, the number of fish factors is over 150; in the former of those ports, the principal buyers made, before the war, over 1 million turnover per year, and for seventy seven of them the yearly transactions did not exceed 21,000 francs. This shows that beside the large buyers, there is a place for the small ones.

We must therefore attract the fish factors as much as possible and the best way to manage that, is to let them hire the stores at reasonable prices; commodious stores like those described above.

The West part of the large dock is limited by a quay of 125 m. (137 yds.), making the continuation of the South-West pier-head whose role will be the same as that of the West quay of the long dock, which we shall speak of farther on.

Altogether, the large dock has 700 m. (765 yds.) of quays on the inside, a variable width of 70 to 185 m. (76.5 to 195 yds.), a depth of 5 m. (16.4 ft.) at ordinary low tides (13.12 ft. below 0) which can be easily increased by dredging.

The long dock is a continuation of the preceding one; at the entrance there is an angle which will be utilised for a floating landing-stage and the construction of a building for the use of the port authorities, a registry office, sailors restaurant, etc.

The East quay will have exactly the same uses as the North quay of the large dock; *it will serve for the sale of fresh fish*

and unloading of same. There will be three buildings similar to those already described and three railway tracks where three more fish trains can be made up.

But as the depth of 16.4 ft. below ordinary low tide will only be obtained on the third of the quay situated farthest South, the Southern third part of the quay will be set aside for steam trawlers, and the other two-thirds for large sailing ships (especially « Dundees » with motors).

The *West quay* (as well as the quay that follows it in the large dock) *will be more specially reserved for the boats (small sailing ships generally) which take fish to be tinned* (sardines, sprats, tunny, mackerel, etc.) ; therefore the land in the vicinity, instead of being used for fish-factors stores, will be utilised for tinning factories. But a large free platform will be provided along the quay, so that it will be possible, if the need arises, to erect small simple markets for the sale of the fish landed there.

The small sailers will also be able to make use of the quay and the docks outside the port, forming the S.-W. part of the great mole. There will be more than 160 yds. of berthing space there, which will be very useful for the boats wanting to unload their catch without losing the time necessary to enter the interior of the port.

The end of the long dock will be occupied by a slip placed cross-wise which can be utilised to draw out of the water, either one ship 80 to 90 m. (87 to 98 yds.) long, or two trawlers, or four « Dundees ». This slip will present the following particularities: instead of the boat hoisted resting on the slip and consequently rendering it unserviceable for other craft, a special arrangement will allow of further drawing the boat on a horizontal plane, then displacing it following its axis and parallel to itself in such a way as to bring it into, as it were, ways which are perpendicular to the longitudinal axis of the long dock. These ways for their part will be lined with workshops with a line of rails going round them, from which branch lines will allow of transporting the necessary materials to the workshops.

With an equipment of this kind, of which one part (the slip itself) would be worked by the port, whilst the ground for workshops could be let to several different shipbuilders, *it would be possible to undertake under exceptionally favourable conditions the building or repairs of ships.*

This is of capital importance for the development of the fishing-port. Indeed, the spots on the coast where ship-yards for small vessels are to be found, are very rare. We can only mention Sables-d'Olonne, Belle-Isle and Paimpol. Now, as we have said above, the Lorient district is especially rich in boats; at Groix alone, before the war, the fleet had a value which may be estimated at 5 million francs and which would be worth the triple to-day. Now, this fleet has to be reconstituted. On the other hand, it must be admitted that a part of the trawlers using the port of Kéroman will be built or repaired there. And supposing that the development of the port conduces to an importance of the same order as Gestmünde (100 trawlers, 200 large sailers, 100 or 200 small ones), that would represent at actual prices a value of 60 to 70 million francs which is of enough importance to let us conclude that ship-yards will be rapidly constructed.

Altogether, the long dock offers 666 yds. of quays, plus 76 yds. of slip, a width of 87 yds., a depth which varies between 13.1 and 16.4 feet below ordinary low tide.

A fishing port must be so equipped that it can provide for the keeping of fish long enough to avoid loss when there is momentarily a great abundance.

The principal thing is the cold-store which allows either to chill or to freeze the fish according to the time it is estimated that it will be necessary to keep it. Chilling which does not require a temperature so low as freezing, but which preserves the fish for a shorter time (a few weeks), can not only be performed in the cold-store, but also in certain parts of the fish-factors stores which will be supplied with cold produced at the cold-store.

Prolonged freezing will demand freezing at a temperature going as low as — 12° C. (10° F.). This is an operation which it will only be possible to perform at the cold-store itself. It is said that for several months past a naturalist of the ocean fishery technical service has been pursuing, at Lorient, experiments of great interest for the improvements of the methods of fish freezing.

The cold-store will also play other roles. In the first place, it will allow of importing frozen fish coming principally from Canada and Newfoundland where the fishery department is having a cold-store built at St Peter. This importation requires that at unloading the ship should be able to discharge its cargo

into a cold-store to be kept in stock, and then sent on in suitable wagons to the inland markets to be consumed or again stocked (1).

The Lorient cold-store will have a stocking capacity of 2,000 tons of fish. The store will be at the same time an ice factory: it will produce 120 tons a day and will be capable of stocking 1,500 tons. The fishing port will thus be sure of not being short of ice.

The store will be situated to the east of the large dock, at a place where the refrigerated boats will be able to use either the 70 m. return quay or the 100 m. outside quay which is a continuation of the south-east mole and at the foot of which a great depth is to be found.

The description of the fishing port would not be complete without a few words regarding the proposed *Oceanographic Institute at Lorient*.

It is seventeen years since the maritime powers of Europe founded an International Union for scientific research concerning the exploitation of that common patrimony that the sea constitutes. France alone did not form part of this Union and she consecrated to oceanographic researches, which are of such utility, ridiculously small sums. Now we flatter ourselves that we shall make up for lost time. The Commissary of the Merchant Marine has recently constituted a scientific fishery office, and the principal establishment of this office will be at Lorient, where a site has been reserved on the South-West mole.

4° *Port railway tracks and junction line with Lorient station. Equipment.*

A fishing port situated in the best nautical conditions, provided with all the most practical arrangements for berthing, repairing, unloading of the boats, the sale and preservation of the fish, the turning to account of all the offal and by-products of fishing, would however be an organ without life if it were not in possession of a system of railway lines so arranged that the forwarding of the fish can be made extremely rapidly and in perfect order.

(1) The fishery service is pursuing simultaneously the realization of all the points of this programme. At the same time as the Lorient cold-store is being built the necessary wagons are being bought and the creation of inland cold stores for a fish is seen to. Frozen fish seems called upon to play a similar part to frozen met, in the matter of alimentation.

A fishing port is, above all, a fish market placed at a station.

In the original scheme, the port was joined to Lorient station by a line which left the branch line of the Kergroise quay and went round the Perrière peninsula. The decision of the Minister of Public Works of the 3rd of August, 1918, pointed out « that » it would be to the interest of the fish-trains to do away with » the necessity for them to follow the lines of the port of Lorient, » which would be of a nature to cause delays ». And requested in consequence that « the possibility of a direct junction of the » lines serving the fishing port with the main line should be » studied ».

The studies which followed, were made in agreement with the Orleans Railway Co., who had made absolutely similar observations to those of the decision of the 3rd August, 1918, and sought the means of obtaining a more direct junction than that originally planned, between the station and the new port.

Within the boundaries of the territory of the port, the proposed railway tracks may be divided into several groups:

1° The fish station and the lines for forwarding the fish which include six make-up tracks, five shunting tracks, a station building, space for three overflow tracks, and eventually a covered market and station for the retail trade;

2° The forwarding lines for the cold-store;

3° The lines serving the coal quay with, behind, in the direction of Kergroise, a group of sidings;

4° The loop surrounding and serving the yards;

5° The lines serving the Western part of the port.

A certain number of these tracks, those destined for forwarding fish, have high platforms to allow of easy loading.

Other tracks are planned on the sites of the new streets.

The total length of the railway lines will be 11.790 m. (12,894 yds.).

These lines cover more than 5 hectares (12 ± 3 acres) of land.

Goods coming from or going to the port will be taxed for the journey between the port and the actual station at Lorient. The tariff will be decrescent according to the annual tonnage of the port and will vary between 2 fr. 50 and 1 fr. the ton.

The ground of the port, properly speaking, has been the object of a survey for the tracing of streets and the approaches.

The equipment of the port must be arranged, as has been already said, so as to avoid all loss of time.

We have already mentioned the coal conveyors, the slip, the special apparatus for unloading fish. We will add that all the fish and ice trucks will be, in principle, of the American type with accumulators which are more and more employed in works and in certain port installations (American port at Bassens in particular). At the opening of the cold-store these appliances will be put into service in the following manner: the imported frozen fish will be unloaded on to these trucks each of which can carry about 1 4/5 tons, these trucks will enter the lifts situated at the four corners of the store, will be raised to the storeys, then they will leave the lift and pass along a large circular corridor surrounding the stocking rooms, into which they will enter to deposit the load, then go down again empty by the same lifts.

5° *Possible extension of the port. — Expropriations and form of administration. — Estimate of the expenses. — Conclusions*

The extensions foreshadowed will give 5 hectares (12.3 acres) of sheltered water, 16 hectares (39 1/2 acres) of platform and more if needed by acquiring new ground to the West and to the North, 1,800 m. (1,883 yds.) of quays.

With this extension the port would be larger than is at present the largest fishing port of the world, i.e. Grimsby.

With the dimensions provided for immediate realisation, the surface of the port will be composed of:

Water . . 8 hectares (19 3 4 acres)
Land . . . 46 hectares (114 acres) } 54 hectares (120 3 4 acres).

The 114 acres of land are divided into:

For public circulation (roads, quays, etc.)	24.71	acres.
Markets, fish-factors' stores (to be let), sailors' home, administrative buildings, post, telegraph, etc.	4.94	acres.
Cold-store, oceanographic institute, coal wharf	3.706	acres.
Station and tracks	12.35	acres.
Slip, building-yards (to be let)	14.82	acres.
Other building sites (to be let)	51.9	acres.

About 40 acres will be reclaimed land and the rest will be acquired either by private contract or by expropriation.

The table herewith allows of comparing the future port of Lorient with some of the best known foreign ports.

Comparison of the fishing Port of Lorient-Keroman with some Foreign Ports.

Fishing port of LORIENT-KÉROMAN		*Comparison with other ports*	
Water surface			
Large dock	12.77 acres	HULL	19.3 acres
Long dock	6.52 acres	ABERDEEN	21.5 acres
Total	19.29 acres	IJMUIDEN	19.3 acres
Possible extension	12.35 acres	GESTMUNDE	17.8 acres
		CUXHAVEN	6.7 acres
		GRIMSBY	27.3 acres
Lengths of quays and slips			
Large dock (inside)	765 yds.	GRIMSBY	2,438 yds.
Long dock	743 yds.	IJMUIDEN	1,310 yds.
Exterior	580 yds.	GESTMUNDE	1,967 yds.
Total	2,088 yds.	CUXHAVEN	690 yds.
Possible extension	1,970 yds.	ABERDEEN	1,420 yds.
		HULL	2,400 yds.
Depths		ABERDEEN : 13 to 16.4 ft. below low neap-tide.	
		IJMUIDEN : 16.1 ft. below low neap-tide; thus : 9.84 ft. below the lowest tides.	
Large dock : 16.4 ft. below low water (1).		GESTMUNDE : 14.4 ft. below low tide.	
Long dock : 13.12 ft.		CUXHAVEN : 14.8 ft. below low tide.	
		Ports with locks and floating docks	GRIMSBY : 6.56 ft. at entrance in the docks. HULL : 6.56 ft. at entrance, 23 ft. in the docks.
Area of markets and shops susceptible of being let to fish-factors.			
Large dock	75,750 sq. ft.	GESTMUNDE	188,300 sq. ft.
Long dock	82,300 sq. ft.	CUXHAVEN	82,850 sq. ft.
		IJMUIDEN	72,032 sq. ft.
Building sites			
Existing sites	74.1 acres	Very variable.	
To be reclaimed from the sea	39.5 acres		
Total	113.6 acres	GESTMUNDE	149.4 acres
Possible extension	24.7 acres		

(1) The low tides are at the level + 3.28 ft.

Data for Lorient :

Exceptionally high tides	+ 18.7 ft.	Low tides neap	+ 6.56 ft.
High spring tides	+ 16.4 ft.	— — Spring	+ 3.28 ft.
High neap tides	+ 13.12 ft.	— — Exceptional	+ 0.00 ft.
Average water level	+ 9.84 ft.		

The creation of the port will require expropriations for which article 2 of the new law of the 12th November, 1918 on expropriation will be applied. This law is conceived as follows:

« The utility of the expropriation may be declared not only for » the areas comprised within the perimeter of the proposed public » works, but also for all those that may be recognised as being » necessary to secure the full value immediate or future of these » works. »

These areas include the land indispensable for the construction or roads, railway lines, the station, the factories, building-yards, etc.

The sites not incorporated in the public works properly speaking will only be used for trades, industries, administrations, services, etc., connected with fishing.

The sites will not be resold, but they may be exchanged for others, for instance, in cases where this would be useful from the point of improving the arrangement of the port. It might, as a matter of fact, be feared that after having sold land to buyers who had declared that it was for a fishery industry, that it would serve for other purposes.

Such an eventuality can be provided against by only letting the land with clauses cancelling the lease, when the intended use of the land is modified without previous permission from the port authorities.

But, in order that leases of this kind may allow serious tenants to build factories without having to take into account the amortization of the installations in a short period of time, very long term leases will be admitted. This is the solution that has been adopted at IJmuiden, where the Dutch State gives leases for terms reaching 60 years.

Naturally, the letting of these lands, taking into account the considerable plus-value that they will have acquired, will allow the State to get back an important part of the sums spent on the construction of the port.

It is perhaps a little premature to speak of the future manner of working the port.

Other countries offer numbers of different systems. In England, these ports are often conceded to Railway Companies and constructed by them. In Holland, IJmuiden, created by the

State, is run by functionaries. The same applies to Cuxhaven which is the work of the State of Hamburg. On the other hand, Gestmünde, constructed by the State of Prussia, is worked by a kind of society called « Cooperative », with members representing the principal persons interested in the development of the port.

The draft of the law deposited by the « Commissaire » of the Mercantile Marine, of which it has already been question, provides for the following in article 4 of same:

« Fishing ports formed in execution of the present law may » be placed for their exploitation, at the disposal of groups con- » stituted by municipalities, Chambers of Commerce, professional » organisations of ship-owners and fishers and of other corpor- » ations specially interested in the working of the ports.

» This exploitation can also be undertaken in the conditions » stipulated in the preceding article (1).

» In any case, the receipts derived from the working of a fish- » ing port, shall be entirely devoted to the up-keep, working and » improvement of the port as well as to the setting aside of a » reserve fund.

» A decree countersigned by the Minister of Finances and the » Minister in charge of the Mercantile Marine will determine in » each case the conditions under which the exploitation of fishing » ports as above mentioned will be undertaken, and also the » general administrative rules of these ports. »

The *general detailed estimate for the works amounted to 25 million francs*, comprising 22,700,000 francs for works of prime necessity and 2,300,000 francs for works of minor necessity.

These latter are, the west quay of the long dock which, doubtless, will not be necessary immediately, and two of the three groups of markets and shops of the long dock which would only be built when the development of the fish trade would require same. For the greater part of the works, the prices reckoned are about three times those reigning before the war.

The above estimate does not include the building of the cold-store which, with all the supplementary works added, will require an outlay of 5,800,000 francs.

(1) « That is to say confided to either public institutions or to associations recognised as of public utility, or to syndicates or unions of professional syndicates, or to limited liability or cooperative companies. »

The advantages to be expected from the execution of the works follow from the preceding explanations. They are of several different orders:

In the first place, they will allow all the enterprises depending on fishery (shipowners, factories, etc.) to lower their prices. Indeed, the creation of a fishing port will permit of the sale of fish wholesale under more economical conditions than is actually the case, the supplying of boats with coal, ice, etc., under less onerous conditions also. It will be possible to careen and repair boats which, at the present time, must be sent to fairly distant ports for this purpose, and this increases the costs and at the same time diminishes the supervision of the owners.

Other advantages consist in the fact that it will be possible to avoid the loss of the products of fishing, so highly perishable, either because they are not transported in time by the railways, or because, in case of abundance, they cannot be chilled or frozen and stocked so as to be able to wait for the passing of the temporary surplus.

The construction of the fishing port will therefore be of considerable local interest. It will attract industries, capital, a new population to Lorient and the town may hope to see an era of prosperity open for it recalling the happy days of the Compagnie des Indes.

A fishing port like Lorient is not simply a work of local interest, or even of the district. It is essentially *a national work*, by reason of its being of a nature to increase the supply of food of the first order, to regulate the distribution to the population and to diminish the price.

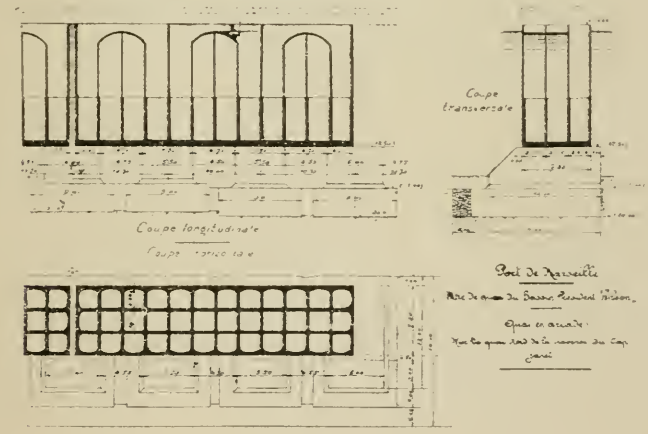
(*From the note supplied, in August, 1919, by* Mr. Verrière, *Ingénieur en chef, Directeur des Travaux du Port de Pêche et du Frigorifique de Lorient.*)

PORT OF MARSEILLES

Construction of the quay north of Cape Janet traverse.

This work was authorised by ministerial decision, dated the 11th of February, 1919.

The object in view is to continue towards the North the creation of new docks for the port of Marseilles. To « President Wilson » dock, now in course of completion, must follow the « Mirabeau » dock, these two docks being separated by the Cape Janet traverse, of which the South quay alone was planned in 1919.



The works proposed and actually in course of realization consist in the constructing of a 315 m. (345 yds.) quay, to the North of the Cape Janet traverse, with a quay 25 m. 60 (28 yds.) long to the shore.

These quays are formed by large cases 30 m. × 7 m. 50 × 13 m. (32.8 yds. × 8.2 yds. × 14.2 yds.) of cement concrete with foundations at the level — 12 m. 50 (— 41 ft.) ; they rest on the solid ground either through a not very thick continuous foundation, or cement concrete pillars made by means of a portable compressed air caisson. These cases were lightened by only being filled

with lime concrete plumb with the foundation pillars: thus a kind of arcade quay was realised more economical than the full quays employed for the President Wilson dock.

The total cost of the works is estimated at 4,050,000 francs, but this figure will be exceeded by reason of the constant rises in the prices.

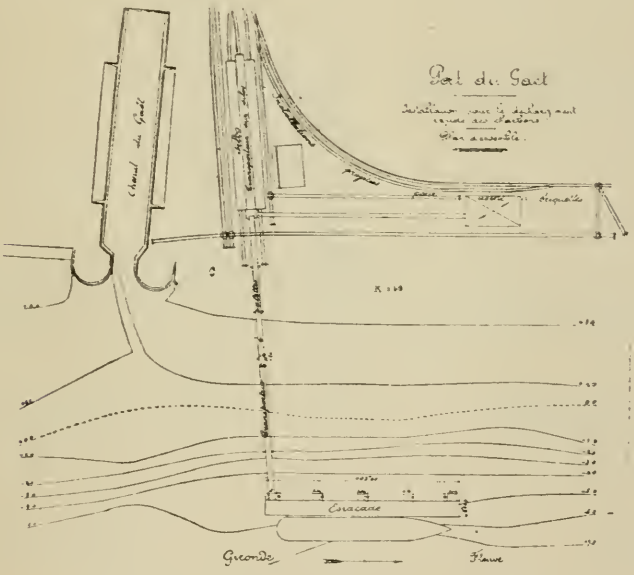
The cost is supported, half by the State, half by the Marseilles Chamber of Commerce, the latter borrowing the necessary sums and guaranteeing its loans by the product of the tolls from ships frequenting the port of Marseilles, these tolls were created at the time of authorising the construction of the President Wilson dock.

(From information supplied, in July, 1920, by the Ingénieur en chef du Service Maritime des Ponts et Chaussées, 1, quai de la Joliette, Marseilles.)

PORT OF PAUILLAC

1° Works foreshadowed : Plant for unloading and handling mazut at the Pauillac-Trompeloup public wharf.

This plant will include the equipment necessary to allow of unloading to shore, to wagons or to barges and the placing in bunkers of mazut and will serve indistinctly the six berths capable of receiving ships drawing 9 m. (29.5 ft.).



Port of Gaët

Installation pour le déchargement rapide des charbons = Installation for the rapid unloading of coal. — Plan d'ensemble = General plan.

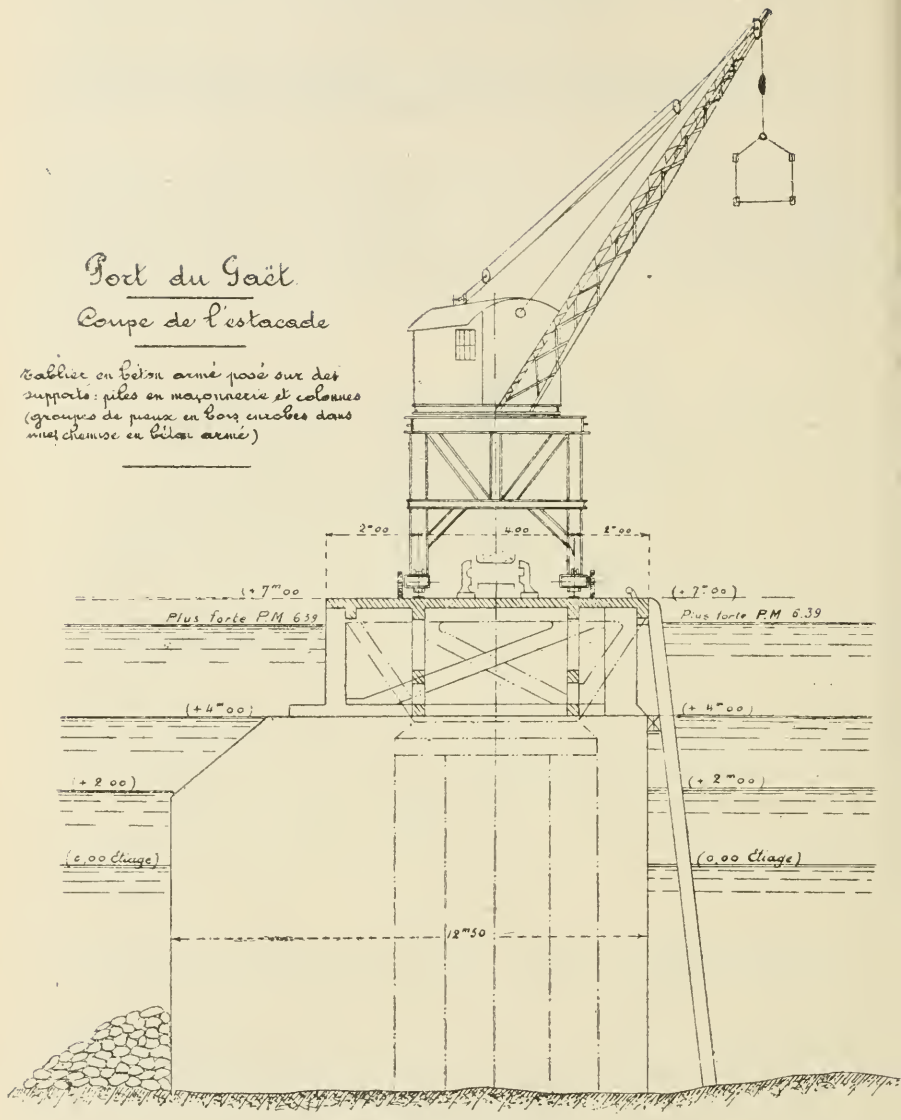
It will be the object of a private authorisation with compulsory public service, the cost of the equipment being for the holder.

2° Works finished in 1918 and 1919.

A. *Installation for the rapid unloading of coal*, including :

A mole in the river, a conveyer and pits for 4,000 tons.

The mechanical equipment of this installations allows of unloading ships drawing 7 to 8 m. (23 to 26 ft.) and the placing


Port du Gaët
Coupe de l'estacade
Tablier en béton armé posé sur des supports : piles en maçonnerie et colonnes (groupes de pieux en bois enrobés dans une chemise en béton armé)
2m00
4.00
2m00
(+ 7m00)
Plus forte PM 6.39
(+ 4m00)
(+ 2 00)
(0,00 étiage)
12m50

Port of the Gaët

Coupe de l'estacade = Section of wharf. — Tablier en béton armé posé sur des supports : piles en maçonnerie et colonnes (groupes de pieux en bois enrobés dans une chemise en béton armé = Reinforced concrete floor laid on supports : masonry piles and pillars (groups of wooden stakes cased in reinforced concrete).

in wagons of coal at the rate of 200 tons per hour (stock of coal for the Midi system).

The wharf is 105 m. (114.5 yds.) long. The pit is 80 m. 15 (89 yds.) and is supplied with 48 hoppers served by three railway tracks.

The works are entirely made of reinforced concrete.

The cost of the works amounted to 2,710,000 francs, of which 2,245,000 francs were booked to the account of supplementary works of the properly called first expenses of the Midi Railway Co., and 465,000 francs were set down to the first expenses account for the working-stock of this Company.

The installation is interesting from a financial point of view because of the possibility for the Midi Co. to effect, under better conditions than formerly, the supply of coal to their system.

The costs should have been, according to the contract, 1,740,000 francs.

The difference is due, for 663,000 francs, to reasons of a technical order, and for the rest, to economic circumstances.

B. *Extension of the maritime station of Pauillac-Trompeloup.* — Tracks and warehouses. — Building of a timber wharf for ships drawing 3 m. 50 (11.5 ft.) and for stocking coal.

These works comprised the laying of 10,300 m. (11,260 yds.) of tracks and the construction of 25,070 sq. ft. of warehouses for the needs of the revictualling service and for the American Naval base as well as the construction of a wharf to supply coal to the Naval base. (Now used for commercial purposes.)

(From information supplied, in May, 1920, by Mr. Clavel, *Inspecteur Général des Ponts et Chaussées, 2, rue Jean-Jacques Bel, Bordeaux.)*

PORT OF ROCHELLE-PALLICE

1° Two ministerial decisions dated the 13th of February and 7th of October decreed :

a) *The excavating in the outer harbour, at the foot of the North jetty, of a channel* 300 m. (328 yds.) long, 30 m. (32.8 yds.) wide and 4 m. (13.12 ft.) deep (from the level — 16.4 ft. the bottom of the outer harbour to the level — 29.52 ft.).

The works are nearly finished.

b) *The enlargement of the already existing channel at the foot of the wharf called « Pétroliers ».*

This channel, which had the following dimensions :

Length	116 m. (126.8 yds.)
Width	15 m. (16.4 yds.)
Bottom at the level	— 7 m. (—22.97 ft.)

has been enlarged so as to present the hereafter dimensions :

Length	139 m. (142 yds.)
Width	25 m. (27.3 yds.)
Bottom maintained at the level ..	— 7 m. (—22 97 ft.)

The work is finished.

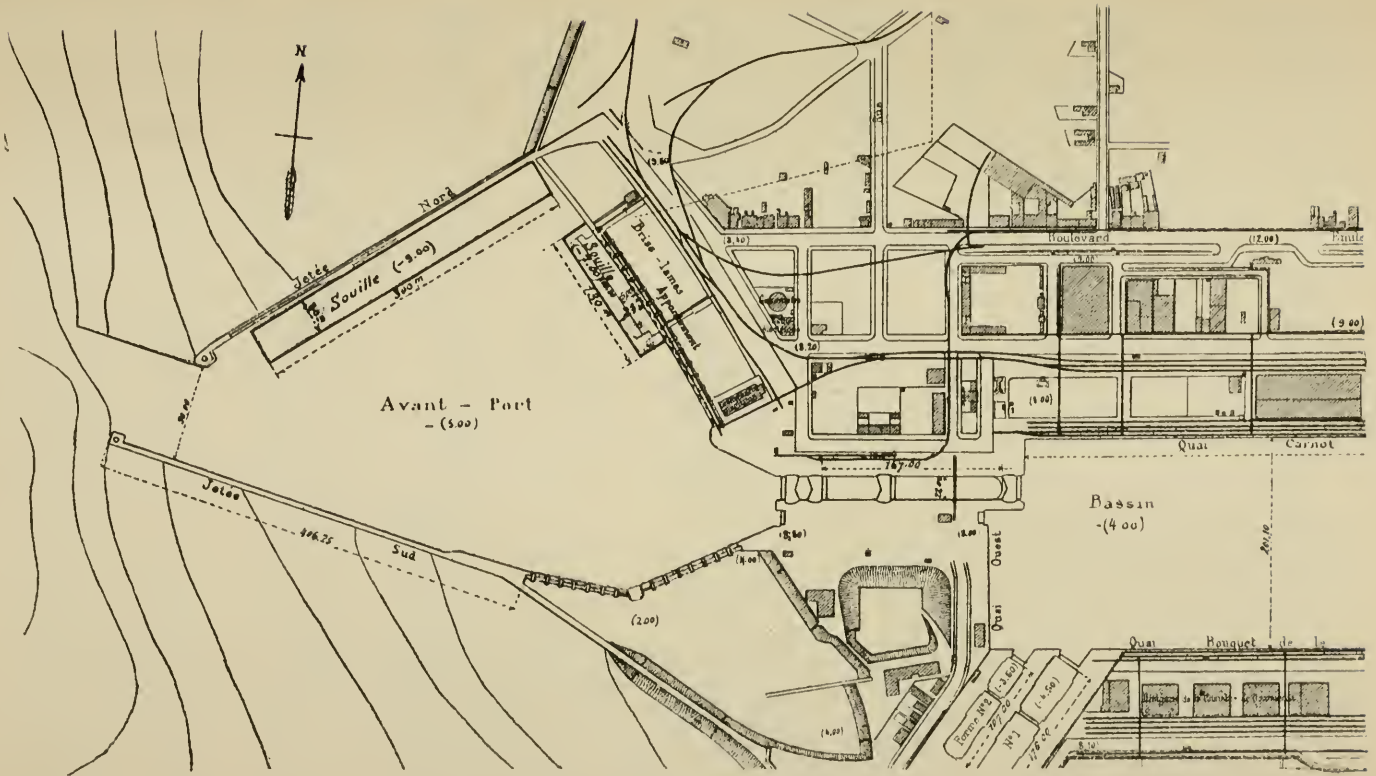
The excavation of the channel of the North jetty and the enlargement of the one of the « Pétroliers » wharf, were decided upon during the hostilities to allow of receiving the large american tank-steamers.

The expenses resulting from the execution of these works were estimated at 1,299,000 francs.

They are borne by the State and the parties interested : petroleum works and the La Rochelle Chamber of Commerce. The cooperation funds amounted to 684,500 francs in all. The States part was therefore 614,500 francs.

The two new berths created along the North jetty will be reserved by priority for oil ships and for those importing mazut.

2° A decree of the 27th December, 1916 declared of public utility *the work of lengthening the wet-dock on a distance of 164 yds. towards the East.*



Port de La Rochelle-Pallice

To effect this extension, it is necessary, in the first place, to turn the lines which connect La Rochelle-La Pallice with the lines of the South quay, and this deviation entails that of the national highway n° 22 and of the South encircling road as well as the rearrangement of the corresponding platforms.

The definite plan for these preliminary works has been approved. The works are being executed.

As regards the scheme for lengthening the dock, it has not yet been submitted for the approval of the higher Administration.

The lengthening of the wet-dock was decided on with the object of supplying the dock with three new berths and thus to cope with a traffic which, from 530,000 tons in 1913, rose to 1,300,000 tons in 1917.

The extension will be executed on a length of 150 m. (164 yds.) towards the East. The new part will be excavated to the same level as the rest of the dock, i. e. to the level —4 m. 50 (—14.76 ft.).

The first part of the extension works was estimated at 3 million 200,000 francs, including 1 million francs for the acquisition of the necessary land for the whole of the works (first and second parts).

The whole of the extension works were estimated at 7 million 900,000 francs.

The La Rochelle Chamber of Commerce bears two-thirds of the expenses.

The three new berths obtained by the extension of the dock will allow of increasing the traffic of the port by about 250,000 tons of goods per annum.

(From information supplied, in October, 1920, by Mr. Lombard, *Ingénieur en chef des Ponts et Chaussées, 5, rue de la Cloche, La Rochelle.)*

PORT OF ROUEN

1° Works decided on in 1918.

The law of Aug. 26th, 1913, declared of public utility a programme of works to be carried out for the improvement of the port and its approaches, which include principally.

a) The improvement of the approaches between the port and the river La Risle, near the mouth of the Seine; on a length of about 120 km. (75 miles) by removal of earth, construction of longitudinal dikes and dredging;

b) The construction of docks in the St-Gervais meadows;

c) The construction of quays on the right bank of the Seine and on the left bank to the entrance of the dock aux Bois;

d) The construction of a graving-dock and a quay for fitting out and repairing ships at the entrance of the petrol-dock;

e) Dredging to deepen the downstream part of the port.

The object of these works is to allow ships of a draft of 8 m. (26.24 ft.) to reach Rouen at all tides.

* * *

a) *Improvement of approaches.*

The object of these works is to give the bed of the Seine such dimensions in width and in sections, in every part as to obtain a sufficient depth between Rouen and La Risle for vessels drawing 8 m. (26.24 ft.) of water to reach Rouen at any tide, even the lowest, and to permit vessels of a draft of 6 m. 50 (21.3 ft.) to descend the river directly at all tides; at present, on the contrary, if ships of a draft of 7 m. (23 ft.) even 7 m. 50 (24.5 ft.) and indeed 8 m. (26.24 ft.) can go up the river with a favourable tide, the depth of water which can be counted on at any tide, scarcely exceeds 6 m. (19.7 ft.).

The works include dredging in the bed of the river of the disintegrable sills, the removal of the banks in the portions of the river which are too narrow, damming and bank protection.

The dredging and removal of earth are for a volume of 15 millions of cubic meters (19,500,000 yds3) in round numbers, which must be entirely lifted on to the bank.

The dikes and protections of the bank are formed of blocks of rough stone crowned by fillings of chalky rubble of which the surface is protected by a covering of concrete.

In view of these operations, the construction of important dredging material including in particular special engines for landing the produce of the shingle banks must be taken in hand first of all.

b) The rapid and regular development of the port of Rouen necessitates *the construction of new quays*.

For unloading various goods notably wines which demand large platforms in view of their bulk, these quays will be constructed near Rouen in the St. Gervais meadows.

For heavy goods, the quays can be more economically constructed on the Seine.

The characteristics of the docks in the St. Gervais meadows are the following:

Length of the quays	3,660 m. (4,001.6 yds.)
Level at bottom.....	4 m. 50 (14.7 ft.)
Level at top of quay.....	9 m. 50 (31 ft.)
Dredging	4.5 million cubic meters (5.85 million cubic yds).

c) *Quays on the Seine.*

Right bank.....		1,400 m. (1,530.6 yds.)
Level at foot of quays		— 4.50 m. (14.7 ft.)
Level at the top.....		+ 9.50 m. (31 ft.)
L. B.	To the south of the dock aux Bois.....	645 m. (705.17 yds.)
	Level at the foot of quays.	— 3.00 m. (9.84 ft.)
	Level at the top.....	+ 9.50 m. (31 ft.)
	To the north of the dock aux Bois.....	1,000 m. (1,093.6 yds.)
	Level at foot of quays ...	1.00 m. (3.3 ft.)
	Level at the top.....	+ 9.50 m. (31 ft.)

These quays will be built on piles of the Rouen classical type (upper masonry constructed in wooden caissons).

d) *Graving dock.*

The proposed dock will have:

Length.....	160 m. (175 yds.)
With an extension foreseen to	200 m. (218 yds.)
Width at entrance.....	24 m. (26.24 yds.)
Level of sill.....	— 2.80 m. (8.8 ft.)
Level of bed on the axis	— 4.10 m. (13.5 ft.)
Level of coping.....	+ 10.00 m. (32.8 ft.)
Fitting-out quay. Length	275 m. (300.84 yds.)
Level at foot of quay	— 3.50 m. (11.5 ft.)
Level at the top	+ 9.50 m. (31 ft.)

The improvement works of the approaches between Rouen and La Risle were estimated at 40,000,000 fr. at pre-war prices.

The cost is borne as mentionned below for the works of the port of Rouen itself.

The works of the port of Rouen were estimated at pre-war prices as follows:

Saint-Gervais docks ..... fr.	32,740,000.00
Quays of right bank	4,060,000.00
Quays of left bank (North and South banks of the Dock aux Bois).....	3,930,000.00
Graving-dock	6,720,000.00
Total... fr.	47,450,000.00

The first stage of the works has just begun. It includes the works of the first stage of the Saint-Gervais meadows, 540 m. (590.7 yds.) of quays on the river on the right bank, and 628 m. (686.61 yds.) on the left bank.

At present prices, the cost reckoned on for the first portion of the works will reach 76,000,000 francs.

The Chamber of Commerce of Rouen assisted by the Department of the Seine-Inférieure and the City of Rouen, must meet half the cost of these works, thanks to the revenue from tolls levied on ships entering the maritime portion of the Seine.

The other half of the cost will be borne by the State.

The contributions of the Department of the Seine-Inférieure and of the city of Rouen are arranged as follow:

The Department of the Seine-Inférieure will pay 5/24 of the agreed price subscribed by the Chamber of Commerce.

The City of Rouen renounces its right to levy duties upon the materials to be used for the construction of the works.

* * *

2° Works decided on in 1916.

Construction of reinforced concrete landing stages 200 m. (218.7 yds.) long for sea-going vessels on the North bank of the Elie peninsula, at the port of Rouen (La « Société des appontements de l'île Elie », Grantee.).

The landing stages of Elie Island are fixed on cement pilles, the superstructure is also of cement with an encuver containing the ballast on which the railways lines are laid.

The stage can receive two powerful transhipping bridges for unloading coal.

The costs are estimated at 3,200,000 francs.

* * *

3° Works decided on in 1917.

Construction of a quay 250 m. (273 yds.) long, Rouen type at Grand Quevilly, on the left bank of the Seine. (Grantee: The « Rouen discharging Company »).

This quay of the Rouen type suitably reinforced, will be equipped with two large unloading bridges for coal.

The cost is estimated at 3,000,000 francs.

* * *

4° Works decided on and carried out during the war, in the maritime port, maintained after the cessation of hostilities.

Besides the wooden landing stages of Quevilly and the *dumping* stations, construction on the Seine of *50 berths for seagoing vessels*, formed simply of buoys and fenders (ducs d'Albe).

These berths are to be used for discharging coal by cranes.

The coal is transhipped directly into lighters or barges.

These works of which the cost was borne entirely by the State, permitted the port of Rouen to cope with the enormous traffic imposed upon it during the war, as much for the revictualling of the country as for that of the French and allied armies.

Thanks to the rapid and considerable extension of the unloading berths obtained by the use of buoys and fenders, the port of Rouen possesses at the present time 159 unloading berths for sea going vessels, and was able to receive in 1918 more than 10,000,000 tons of goods.

The tonnage discharged at Rouen during the first year after the war of which the results are known, 1919, still exceeded 8 million tons, this port thus easily keeps the first place among French ports from the point of view of the tonnage discharged.

* * *

5° Works finished in 1916 and 1917.

a) *Construction of a maritime quay* (Rouen type) of 713 m. (779.21 yds.) on the North bank of the former Elie Island at Rouen. (Works declared to be of public utility by Decree of Aug. 14th, 1910.)

This quay was constructed by the State for the needs of the traffic of the port of Rouen. It was employed for the first time in June, 1915, but only for half its length. At the end of 1917, the whole quay became available for ocean traffic.

Total length.....	713 m. (779.21 yds.)
Level at top.....	(+ 9.50) (31 ft.)
Level at foot.....	(— 3.00) (9.8 ft.)

The work was carried out by private contract under the control of the 4th section of the Seine Navigation (Port of Rouen Service, 52, quai Gaston Boulet, at Rouen.).

The cost of this work was 2,700,000 francs, the contract price was 2,303,000 francs.

One half of the cost was borne by the State and one half by the Chamber of Commerce of Rouen. The city of Rouen renounced its rights to duties on material used for the construction of the quay.

To the actual cost, must be added 950,000 francs for stone covering and paving not carried out on account of the cancelling of the contract.

b) *Landing stage in reinforced concrete 200 m. (218.72 yds.) long on the left bank of the Seine at Grand-Quevilly.*

This landing stage was constructed by the « Société des Hauts-Fourneaux de Rouen », to serve the works at Grand-Quevilly to the right of which it is built.

Level at the top .... (+10 m.) (32.8 ft.)
Level at foot of landing-stage ..... (—3 m.) (9.8 ft.)

It was necessary to reduce the pressure of the embankment on the rear of the landing stage for fear of an outward displacement. Two rows of piles were driven at the rear of the landing stage on which arches were constructed of dry stone.

The work was carried out under the supervision of M. Freyssinet, Technical superintendent, Boulevard Haussmann, 149, at Paris.

The estimated costs amounted to 900,000 francs.

The cost of the works came to 1,000,000 francs.

Receipts counted on :

Quay dues	32,000 francs.
Local taxes	54,000 francs.

Increase of traffic reckoned on : 160,000 tons.

6° Works connected with the railway lines and equipment.

(Carried out since the war and maintained)

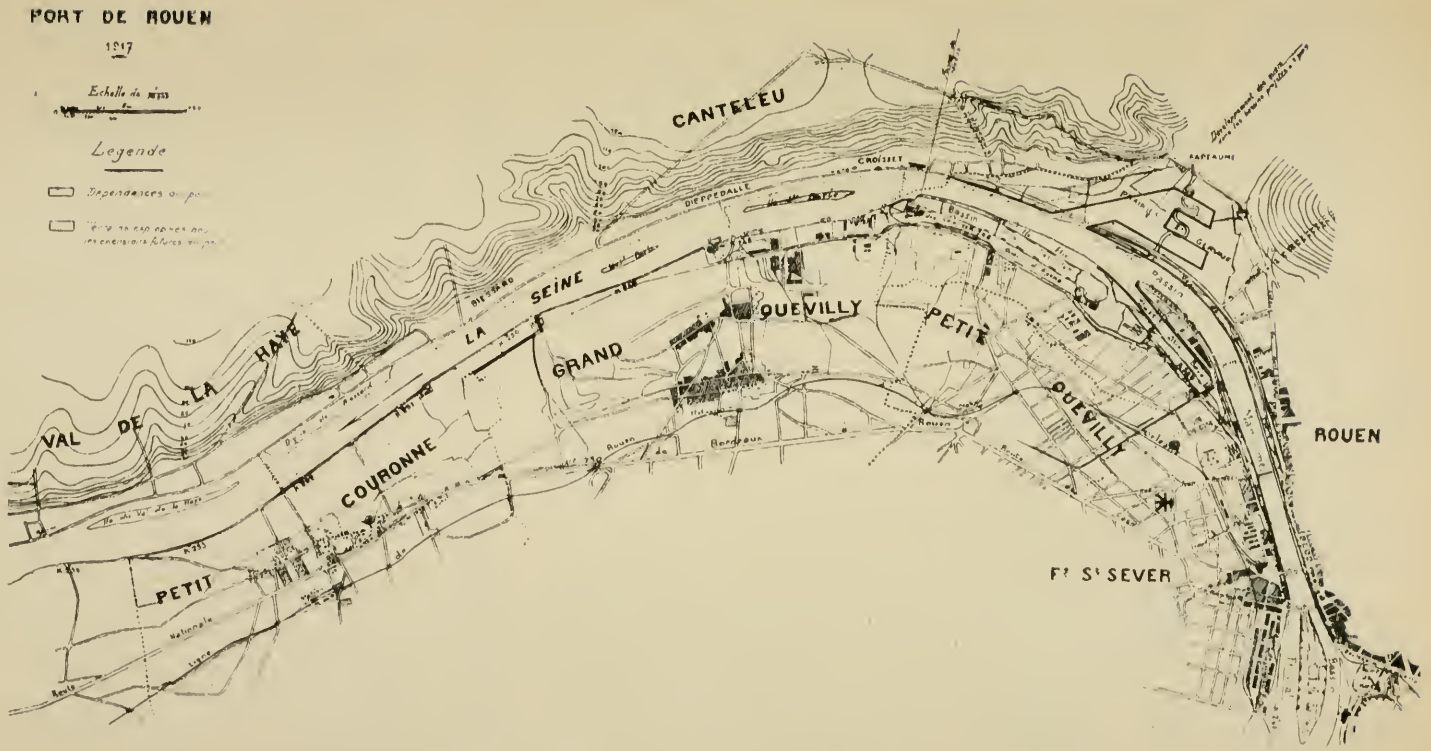
Construction of sidings and shunting lines for the port.

Employment of electric or steam cranes on the quay, floating cranes, special plant for transhipping coal with carriers and pits of reinforced concrete (State railway).

Although 2/3 of the goods unloaded at Rouen are transported by the Seine, it was absolutely necessary to develop the means of transport by railway.

At the present time, a total of 77 kilometers (48 1/8 miles) of tracks serve the quays of Rouen.

Let us only note, among the 282 discharging machines of the port, the plant of the Elie peninsula (2 cranes with automatic



Dépendances du port = Port buildings and offices. — Terrains expropriés pour les extensions futures du port = Land expropriated for the future extensions of the port.

grab of 6 tons) permitting the loading of coal coming from the holds of sea-going vessels on to either lighters or barges, or on wagons, or on an endless belt serving the pits (2 pits in reinforced concrete each of a capacity of 2,000 tons).

(*From information supplied, in September, 1920, by* Mr. P. Barrillon, *Ingénieur en chef du Port de Rouen et de la Seine maritime, quai Gaston Boulet, 52, Rouen.*)

Bibliography. Works connected with Ocean and Inland Navigation, 1913, p. 148.

PORT OF SAINT-NAZAIRE

1° Construction of a reinforced concrete landing stage at the Dock aux Gabares, Penhoët Dock

The object of this work is to link up the quay of the Grands-Puits to the Quay des Charbonniers (West of the Penhoet dock) by abolishing the solution of continuity existing over a length 388 m. (424 yds.), width 26 m. (28.43 yds.), depth 9 m. (29.5 ft.).

The maximum load admitted 4 tons per m2 (1.19 sq. yds.).

The foundations were built on silty ground, of great depth, the process for the foundations employed was piles of reinforced concrete surrounded by a coating, which gave every satisfaction.

The landing stage was constructed under the supervision of Messrs. Mallat and Tartrat, Ingénieurs en chef des Ponts et Chaussées, at Saint-Nazaire.

According to the contract, the cost was to be 1,520,000 francs. The actual cost amounted to 1,715,477.70 francs of which 1 million 065,477.70 francs was borne by the State and 650,000 francs by the Chamber of Commerce.

2° Construction of a wooden landing-stage at Montoir.

This landing stage constructed by American engineers was to serve the great american dump at Montoir, by forming in the Loire 3 high efficiency berths for large cargo boats with direct connection by rail to the dump and to the port of Saint-Nazaire.

The principal mesurements are the following: length of landing-stage 600 m. (656 yds.), width 36 m. (39.36 yds.), depth at low tide from —9 m. (29.5 ft.) to —6 m. (10.7 ft.), length of entrance pier 1,200 m. (1,312 yds.), width 7 m. 50 (8.2 yds.).

The landing-stage is only finished on a length of 427 m. (466.52 yds.). It is provided, on this section, with a shed 414 m. (452.3 yds.) long and 15 m. (16.4 yds.) wide.

Special difficulties were not met with during construction except for the marshy ground of great depth where the piles were driven.

The cost is not known (war work).

(From information supplied, in May, 1920, by Mr. BONISSEAU, *Ingénieurl en chef des Ponts et Chaussées, at Saint-Nazaire.)*

Bibliography : EPINAY : **Travaux en cours et en projet au port de Saint-Nazaire.** *Annales des Ponts et Chaussees* 1912, fasc. III.

ALGERIA

OCEAN NAVIGATION

SEA PORTS

PORT OF ALGIERS

A. — Works for the completion of the inner port of the Agha.

Extension of the Agha jetty on a length of about 550 m. (602 yds.) and building of the large mole 656 yds. × 160 yds. and construction of two minor jetties of 82 yds.

To the main enterprise have been added successively:

1° Lengthening of the small 110 m. mole by 100 m. (109 yds.);

2° Construction of the Al-Djefna mole, about 150 m. (164 yds.) × 175 m. (191 yds.).

3° Construction of the Admiral-Mouchez mole, 100 m. (109 yds.) × 200 m. (219 yds.) and bringing forward the quay at the bank between this mole and the little mole by about 200 m.;

4° Construction of a groin 200 m. (219 yds.) long to the South of the large mole;

5° Cutting down of the « Sans-Nom » rock (completed in 1913) by the removal of about 12,000 m3 (15,600 cub. yds.).

B. — Widening works at the North of the Admiral Mouchez mole.

Carried out by the authorities in 1913-1914.

The total cost of the works was about 12 million francs.

The expenditure was borne, partly by the Chamber of Commerce, partly by the State, for the main enterprise, for the rest by the Chamber of Commerce.

The Chamber of Commerce was authorised to borrow and to guarantee its loans on the revenues from lands and tolls.

The tonnage of the port was:

In 1906, commencement of the works....	2,270,000 tons.
In 1910, completion of the main enterprise	3,146,000 »
In 1912	3,643,000 »

The receipts will be stated by the Algiers Chamber of Commerce.

The main enterprise, begun in 1906, was finished in 1910, nearly a year before the time stipulated.

The works were executed under the direction of Mr. Coustolle, Ingénieur en chef des Ponts et Chaussées (1), assisted by Mr. Butavand, Ingénieur ordinaire, and Messrs. Chevalier and Maleval, Sous-Ingénieurs.

(From information supplied, in May, 1920, by Mr. BUTAVAND, *Ingénieur en chef des Ponts et Chaussées, ff. d'Ingénieur ordinaire, 3, rue Berthelot, Algiers.)*

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(1) The cutting down of the « Sans nom » rock and the widening of the Admiral-Mouchez mole were done after the departure of Mr. Coustolle, who was replaced by Mr. Gauckler.

PORT OF ARZEW

The extension works of the port, completed in 1912 (see plan herewith) were intended to form a *dock protected from the East winds* and accessible to ships of large tonnage, also to form *new platforms for the handling of goods*.

To this end the North platform between the Great Quay and mole n° 3 has been widened on a length of 232 m. (256.68 yds.).

Mole n° 3 was prolonged by 158 m. (172.80 yds.) and widened so as to bring its new width to 60 m. (65.6 yds.), its East and South fronts have been provided with quays.

The Great Quay was prolonged by about 100 m. (109.36 yds.) with a width of 40 m. (43.7 yds.) at the end, its West and South fronts provided with quays.

Dredging and removal of rock were carried out between mole n° 3 and the Great Quay, in such a way as to give a minimum depth of 5 m. (16.4 ft.) towards the end of the basin and 7 m. (23 ft.) at the entrance.

The cost of the works was estimated at 1,200,000 francs. The sum of 1,168,000 francs, the contract price, has not been exceeded.

Only one alteration has been made to the original scheme which fixed the width of mole n° 3 at 40 m. (43.7 yds.).

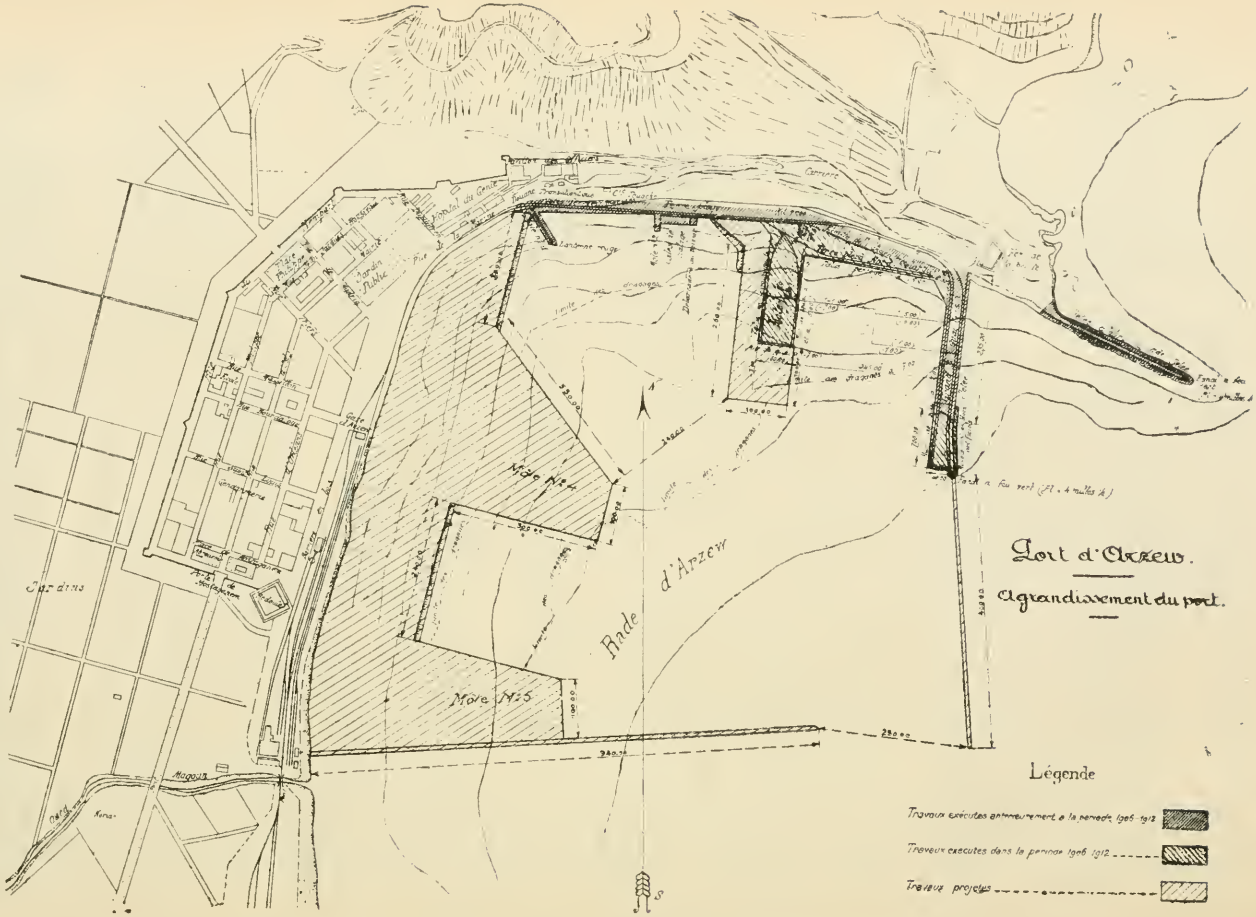
During the construction of the works, the township of Arzew obtained permission to have this width extended to 60 m. (65.6 yds.).

The works were carried out under the supervision of the chief engineer of the West of Oran District.

The costs were borne by the township of Arzew to the amount of 750,000 francs and by the Colony for a sum of 450,000 francs.

The township of Arzew bore part of the costs in the form of subsidies paid to the Treasury in proportion to the progress of the works.

The township of Arzew has been authorised to contract a loan equivalent to its contribution and guaranteed by the produce of a toll levied in the interests of the town.



Port of Arzew. — Extension of the port.

Rade d'Arzew = Roadstead of Arzew. — Môle = Mole. — Carrière = Quarry. — Jardins = Gardens.

An annual revenue of about 40,000 francs was expected taking as a basis the annual traffic during the years 1899-1901, varying from 115,000 francs to 140,000 francs.

The traffic has risen progressively and reached 574,000 francs in 1913, the toll dues attained 91,000 francs in 1912.

* * *

A proposed scheme was drawn up in addition to supply the needs which will be felt in the future. (See plan.)

It includes *maritime works destined for the enclosing of the port* and *the commercial works necessary for the traffic.*

The *works for enclosing the port* consist essentially in the lengthening of the East Jetty (or Great Quay) by 400 m. (437 yds.) and the building of a jetty, known as the South Jetty, 940 m. (1027.7 yds.) long near the mouth of the Oued Magouin.

The *commercial works* include:

1° The construction of the moles designed on the plan under the nos. 4 and 5 along the West part of the port included between the present small mole 1 and the South Jetty to be constructed;

2° The widening of mole n° 3;

3° Dredging (without removing of rock) between these moles at depths of (— 7 m.) to (— 5 m.) (23 ft. to 16.4 ft.).

The works have been estimated for the whole of the programme at 7,454,000 francs.

The special Commission during the nautical enquiry on the scheme, requested that the order of procedure of the works might be fixed as follows:

1° East jetty on its whole length to insure the protection of the port;

2° Mole n° 4;

3° South jetty.

The higher authorities have adopted this order, but have only considered as works possible to be carried out at present, the lengthening of the East jetty and this only for a length of 230 m. (250 yds.).

The part of the total expenses to be contributed by the township of Arzew, the only party interested, is estimated at 1,000,000 francs at the most, the rest to be paid by the Colony.

No exact computation has been made, as things are at present, as regards the expected receipts or the increase in traffic.

(From information supplied, in October, 1920, by Mr. Borde, *Ingénieur des Ponts et Chaussées, in charge of the Service of the district of Oran, route du Port à la Place d'Armes, at Oran.)*

PORT OF BONE (1)

Construction of a quay 200 m. (218 yds.) long to the South of the large dock.

This quay is to be used for loading iron-ore from Ouenza.

The quay-wall formed by 6 layers of artificial blocks placed one on another, is laid at the level (— 11 m.) (32.8 ft.) on a foundation of rough stone. The top of the quay-wall is brought to the level (+ 1 m. 40) (4.6 ft.). The platform has a width of about 75 m. (82 yds.) to be utilized in the following manner.

The first 20 m. (21.8 yds.) from the edge of the quay are used for the track of the loading machine. This latter receives the iron ore coming from the trains, which run on raised tracks placed immediately behind on a reinforced concrete landing-stage about 8 m. (8.74 yds.) wide.

The platform behind the landing-stage for a width of 47 m. (51.35 yds.) will serve for stocking the ore. It will be provided with tunnels and an overhead travelling crane for removing the ore stocked.

A part of the works, less than a third, was carried out by the Society of Research and Execution of the Great Works of Bone. The undertaking was realised in December, 1918.

The works were resumed and finished by the Bone « Service of Roads and Bridges ».

No special difficulties were met with in course of construction.

However the precautions taken for the strengthening of the platform are worthy of note.

The sea-bottom at the level (— 4 m.) (13.12 ft.) on which

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(1) See also the publications mentionned below of the Association of Navigation-Congresses :

1. An account of the breakwaters and the recent and most interesting applications of reinforced concrete in the sea ports of Algeria.

Report by the federal Gouvernment of Algeria XII[th] International Congress o Navigation, Philadelphia, 1912.

2. Works connected with Ocean and Inland Navigation, 1913.

the platform was to be constructed was formed of sandy clay, resting on a layer of compact clay of great thickness.

The sandy-clay was dredged and a layer of the best beach and sand-hill sand was placed directly on the clay.

Rubbish and quarry refuse masks were placed along the quay-wall and the dikes enclosing the platform in such a way as to avoid the loss of sand through the stone bedding.

The necessity of constructing a platform, able to support loads of ore liable to go up to 18 tons per sq. metre (1.19 sq. yds.) imposed these precautions.

The costs of the works are about 1,300,000 francs.

The expenditure is entirely borne by the Colony.

When the 200 m. (218 yds.) of new wharves are ready for use, they will allow of an increase of traffic of from 750,000 to 1,000,000 tons.

They will produce to the benefit of the Bone Chamber of Commerce, which levies tolls, receipts from 337,000 to 450,000 francs when the loading tax for ores has been raised to the rate foreseen.

The costs of execution work out as follows:

a) According to contract	fr.	650,000.00
b) According to sums actually spent:		
1° Contract works and cancellation indemnities		620,000.00
2° Works carried out by the authorities after cancelling contract		980,000.00

The difference arises from the increases in the prices of labour, of material delivered during the course of the works and also because of the unforeseen dredging of which we have already spoken.

The work was commenced in October, 1915. It was suspended during some considerable time, during and after the cancelling of the contract.

(From information supplied, in June, 1920, by Mr. Soulèyre, *Ingénieur en chef des Ponts et Chaussées, 1, Cours Bertagna, Bône.)*

PORT OF BOUGIE

The additional works, about to be completed in 1910, included: the construction of a jetty of 420 m. (460 yds.) out to sea, the raising and lengthening of the quay Ribaucour, the construction of the second part of the North-West quay, the construction of the Casbah mole and a connecting jetty, the dredging of the harbour to the level (— 7 m. 70) (25 ft.), and the laying of railway tracks.

These works were declared of public utility by decree of Feb. 28th, 1904 and the final scheme approved March 16th, 1904.

The object of these works was the transformation of the roadstead into a closed port, the port thus resulting having an area of 25 hectares (62 acres).

These additional works were also intended to link up the platforms by railway to the Beni-Mansour line.

The costs, estimated at 1,850,000 francs, amounted to 2,687,600 francs, and were borne partly by the Colony (fr. 1,452,432.27) and partly by the Chamber of Commerce of Bougie (1 million 234,567 fr. 63) by way of a contribution fund taken from the toll dues.

The filling up of the platforms, which was to be made of mud produced from dredging, was changed, during the course of the works, to quarry residue or schistons earth, coming from Sidi-Yaya.

The traffic of the port has not ceased increasing. It has grown from 80,413 tons in 1807 to 277,756 tons in 1910, with 878,046 francs of dues levied.

The works were commenced in September 1904.

(From information supplied, in June, 1920, by l'Ingénieur en chef des Ponts et Chaussées, at Bougie.)

PORT OF COLLO

The *port of Collo* is in the Western part of the bay of the same name, which extends from Cape Bougaroni to Tasrah Point which juts out to the North-East.

At present this harbour only possesses a small jetty about 60 m. (65.5 yds.) in length, running in the direction South 43°30 to a depth of 7 m. (22.97 ft.). From this jetty a quay-wall runs parallel to the coast for a length of about 90 m. (98.4 yds.), then forms an angle to connect normally with the West face of the landing-stage. The platform thus formed has an area of about 43 ares (1 acre).

A decree of May 7th, 1900, has declared the improvement works of the port of Collo to be of public utility. The scheme for the carrying-out of these works, presented to the higher authorities in March, 1910, was approved by Government decision the 6th of April, 1911 and tenders made in June, 1913.

This scheme includes:

1° The construction of a new shelter-jetty projecting for about 125 m. (135 yds.) from the shore, running from North to South and commencing 60 m. (65.6 yds.) to the East of the point where the present jetty is to be demolished;

2° The construction of two quay-walls forming between them a slightly obtuse angle;

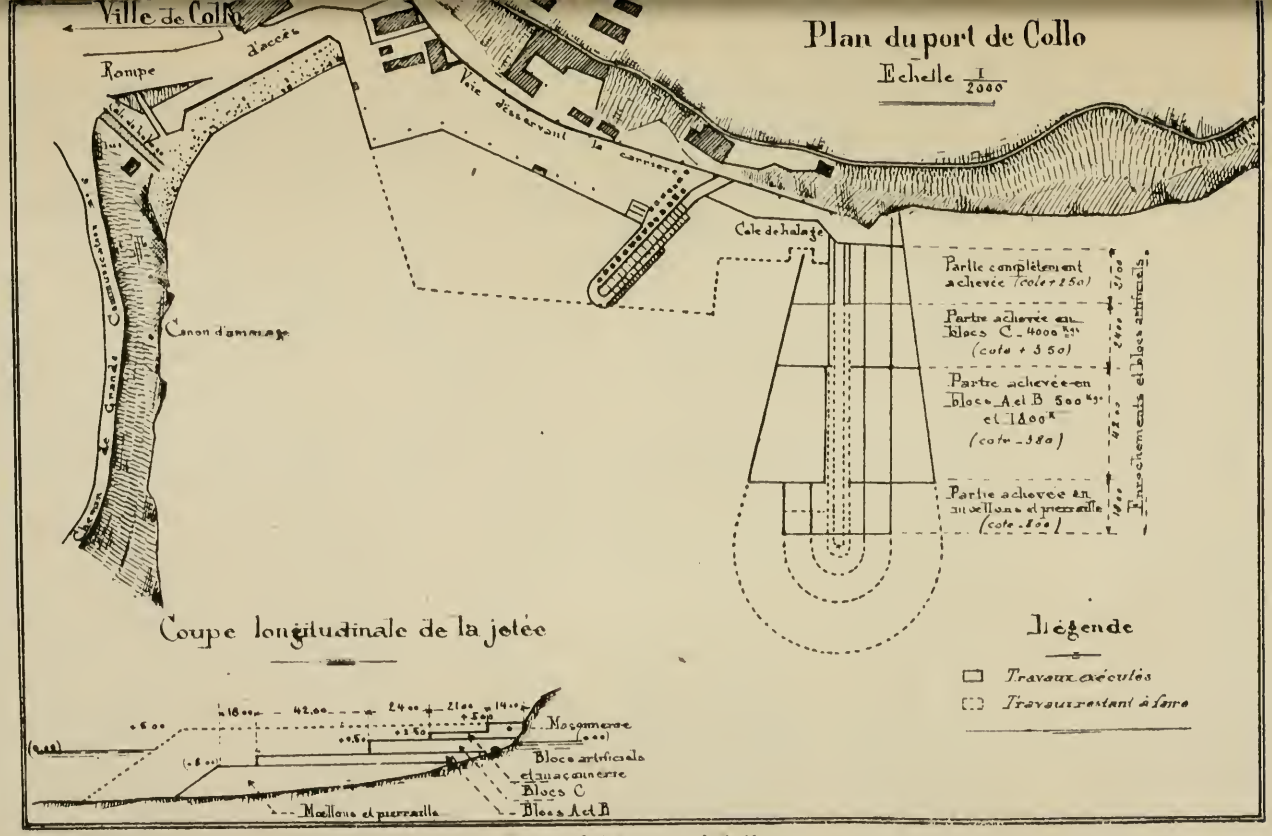
3° The construction of a patent slip for boats and small vessels;

4° The construction of platforms at the rear of the new quay-walls.

The realization of this scheme will obtain a small harbour sheltered by a jetty:

1° A quay where boats can moor running 85 m. (92.87 yds.) inland, with a depth of water along side of 5 m. (16.4 ft.) for a length of 125 m. (135 yds.) and 3 m. 30 (10.8 ft.) for a length of 55 m. (61 yds.);

2° A platform of 12,500 sq. m. (15,000 sq. yds.) of which 10,580 sq. m. (12,650 sq. yds.) will be available for stocking goods;


Ville de Collo
Rampe d'accès
Voie desservant la carrière
Cale de halage
Canon d'amarrage
Jetée en construction
Plan du port de Collo
Echelle 1/2000
Partie complètement achevée (cote + 5.0)
Partie achevée en blocs C 4000 kgs (cote + 3.50)
Partie achevée en blocs A et B 500 kgs et 1400 k (cote - 3.80)
Partie achevée en enrochements et blocs artificiels
Partie achevée en enrochements et pierrailles (cote - 8.00)
Coupe longitudinale de la jetée
Maçonnerie
Blocs artificiels et maçonnerie
Blocs C
Blocs A et B
Moellons et pierrailles
Légende
Travaux exécutés
Travaux restant à faire

Plan of the port of Collo.

Ville de Collo = Town of Collo. — Rampe d'accès = Approach. — Partie complètement achevée = Part completely finished. — Cale de halage = Slip. — Partie achevée en blocs = Part finished in blocks. — Partie achevée en moellons et pierrailles = Part finished in rubble and small stone. — Coupe longitudinale de la jetée = Longitudinal section of the jetty. — Travaux exécutés = Works carried out. — Travaux restant à faire = Works still to be completed.

3° A patent slip for boats and feluccas.

Contract work represented a total expenditure of ..... fr.	1,039,230.00
That done by the authorities, including initial expenditure	120,770.00
Total....fr.	1,160,000.00

The works were commenced in July, 1913 and continued till 1915, when the contractors demanded the cancellation of their undertaking owing to increased prices. This was accepted in consideration of a cancellation indemnity of 175,000 francs.

The total amount expended at the time of cancellation amounted to ..... fr. 613,000.00

A new contract to be executed according to the provisions of the original project, but on the basis of an interest in the work, was sanctioned in November 1919 and concluded with the same contractors. The costs of the works remaining to be executed will in all probability amount to 2,000,000.00

Thus a total of....fr. 2,613,000.00

This expenditure was divided up as follows:

	WORKS completed	to be completed	TOTALS
Funds from loan (Colony).. fr.	226,770.00	338,221.00	565,000.00
Participation fund Township of Collo.....	160,000.00	190,000.00	350,000.00
Ordinary budget of the Colony.	226,230.00	1,471,779.00	1 698,009.00
	613,009.00	2,000,000.00	2,613,009.00

The township of Collo was authorised to impose toll dues the product of which is reserved exclusively for the repayment of the loan of 350,000 francs.

The object in view was less the increase of traffic than its security. It was reckoned that the receipts from the local tolls would be 22,000 francs.

The table below gives tonnage of goods loaded or unloaded and the toll dues levied since the approval of the scheme.

Details of the traffic	1911	1912	1913	1914	1915	1916	1917	1918	1919
Number of ships (Arriv. and depart	884	978	1,089	771	603	858	795	740	823
Burden tons (Arrivals and departures)	304,328	223,781	199,265	162,170	83,011	62,229	36,611	46,347	51,782
Average per ship Tons.	344.262	228.815	182.980	210.337	137.663	74.403	51.930	62.631	62.919
Effective tonnage goods :									
Unshipped. Tons. .	7,264	8,049	7,837.9	6,615.7	4,526.8	3,967.6	4,311.4	3,086.8	3,688 9
Shipped.	10,561	1,423	23,766.2	9,535.7	5,393.0	10,855.9	6,525.5	9,660.9	10,927.2
Totals. . Tons	17,825	22,380	31,604.1	16,051 4	9,919 8	14,823.5	10,836.9	12,747 7	14,616.1
Tolls levied									
Customs and statistics. . . . . Fr.	8,284.26	7,994.98	10,895.00	5,254.50	568.30	1,914.26	2,134 01	2,960.00	2,741.27
Sea dues	10,287.15	8,858 18	11,855.00	6,625.68	810.80	15.45	142.50	12.00	»
Sanitary dues	2,318.40	2,584.00	2,174.90	2,470.00	229.10	692.70	274.90	195.80	1,014.60
Quay dues	144.14	257.69	14.66	15.21	9.92	21.10	19.30	36.04	19.30
Local tolls	31,925.20	25,340.01	31,159.73	18.048.21	9,427.44	14,622.00	9,634.06	13,876.00	1,614.76

(From information supplied, in June, 1920, by Mr. Scotto di Vattimo, *Ingénieur ordinaire des Ponts et Chaussées, at Philippeville.)*

PORT OF DJIDJELLI

Construction of the jetty of Djidjelli.

These works commenced, in 1905, were finished in 1909.

Their object was to protect the harbour against the heavy seas from the North, by a 750 m. (776.47 yds.) jetty, constructed from the West salient of the Citadel to the lighthouse islet.

The jetty is 28 m. 85 (31.5 yds.) wide at the level 0.00, with an inside slope of 1/1 and outside one of 1.5/1.

The works gave rise to an expenditure of 5,520,000 francs, of which 4,895,000 francs was borne by the Colony, and 625,000 francs by the township of Djidjelli.

The township of Djidjelli has been authorised to impose toll dues in order to meet the loan of 625,000 francs which it contracted with the Crédit Foncier for its participation in the enterprise.

The toll dues rose from 18,009 francs in 1904 to fr. 63,347.04 in 1913. During the war they decreased to 22,092 francs in 1918. The figure of 1913 will be easily attained as soon as business has resumed its normal activity.

The traffic, which was 20,207 tons of goods in 1904, had reached 53,792 tons in 1913. It will increase notably after the completion of the railway from Constantine to Djidjelli, the construction of which is under way.

The original scheme forsaw the core of the jetty in artificial blocks resting on a foundation of natural blocks, raised to the level — 5 m. 90 (19.8 ft.), protected laterally by artificial blocks placed by a Goliath crane. Owing to difficulties in execution and the bad quality of the materials, this proposed section was altered; as was also the composition of the jetty: the natural rock work was abolished and replaced by untrimmed artificial concrete blocks, and concrete was also substituted for ordinary masonry for all the other blocks on the slope.

The works were carried out under the supervision of Mr. Dau-

jon, Ingenieur en chef des Ponts et Chaussées, at Philippeville, deceased.

(From information supplied, in June, 1920, by the Ingenieur en chef des Ponts et Chaussées, at Bougie.)

Bibliography : Notes on the construction of the jetty of Djidjelli. ***Annales des Ponts et Chaussées.*** Sept. Oct. 1910.

PORT OF MOSTAGANEM

The object of the preliminary schemes presented in 1910-1912 was:

1° *The deepening of the port, the construction of quays, platforms and a slip*

The dredging was to be carried out to (— 8 m. 00) (26.24 ft.) depth to the North of a straight line connecting the middle of the quays to the red light of the channel and to (— 5 m. 00) (16.4 ft.) to the South of this line so as to obtain flat bottoms at (— 8 m. 00) and (— 5 m. 00) below the zero of the port.

The quay-walls were to have a total length of 330 m. (360.8 yds.).

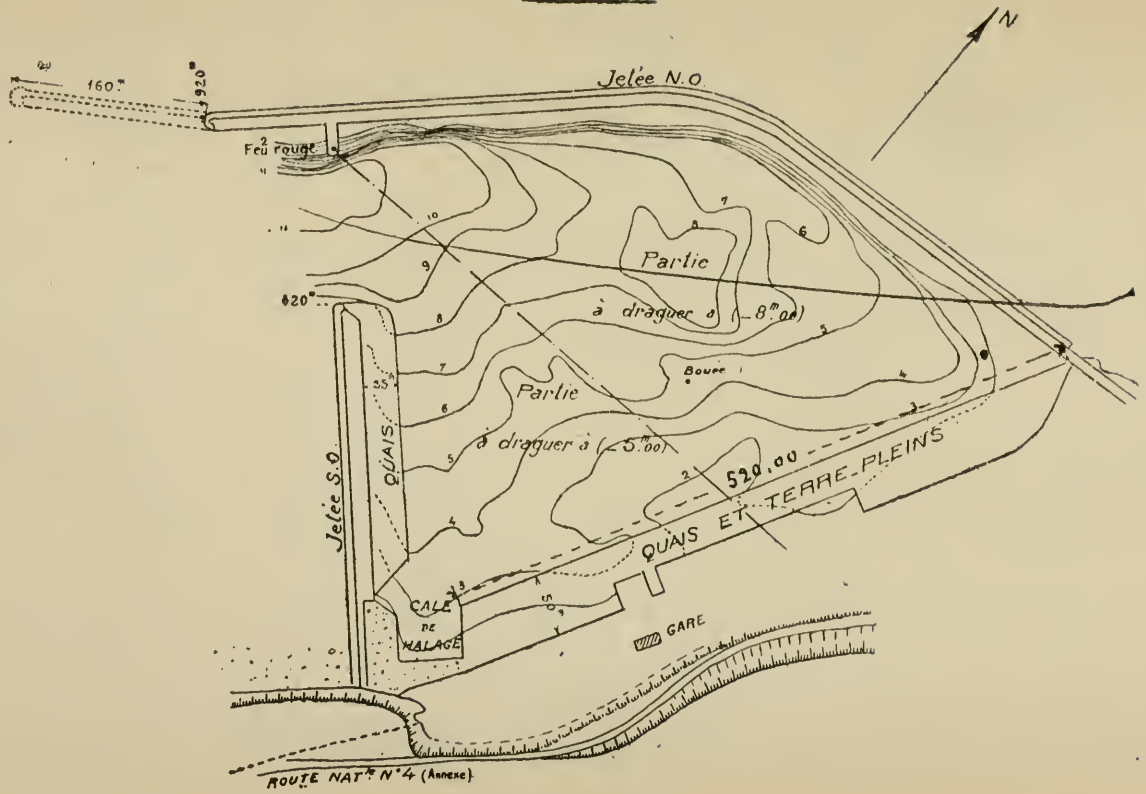
The slip was to present a front of 60 m. (65.6 yds.), a width of 65 m. (71.07 yds.) and a longitudinal slope of 0 m. 065 per meter (65 per 1000).

2° *The lengthening of the large jetty by 160 m. (174.96 yds.) and various accessory works.*

The improvement works inside the harbour were estimated at 5,865,000 francs, those of the lengthening of the large jetty and works pertaining thereto, at 5,000,000 francs.

This expenditure will be borne by the Chamber of Commerce to the amount of 1,200,000 francs, and the remainder by the budget of the Colony.

(From information supplied, in May, 1920, by Mr. LAMBERT, *Ingénieur ordinaire, at Mostaganem.)*



Port of Mostaganem.

Jetée = Jetty. — Terre-pleins = Platforms — Quai = Quay. — Partie à draguer = Part to be dredged. — Cale de halage = Slip. — Gare. = Station.

PORT OF NEMOURS

The construction works of a *harbour of refuge* being carried out at Nemours, include:

1° *The construction of two jetties:* the one called the North Jetty, the other the West Jetty (works of the first stage);

2° *The construction of a breakwater and quay-walls and dredging work* (works of the second stage).

The first stage of the works can be considered as completely finished; at present the finishing touches to the inner and outer embankments are being terminated.

The construction of a harbour of refuge at Nemours will serve advantageously the whole French region to the West of Tlemcen, the Plain of Marnia, Southern and finally Eastern Morocco. At present these regions are too far from Oran and undoubtedly the port of Nemours, when finished, will become the natural outlet for the whole country which suffers to-day from lack of communications.

The dimensions of the works (see figure) are as follows:

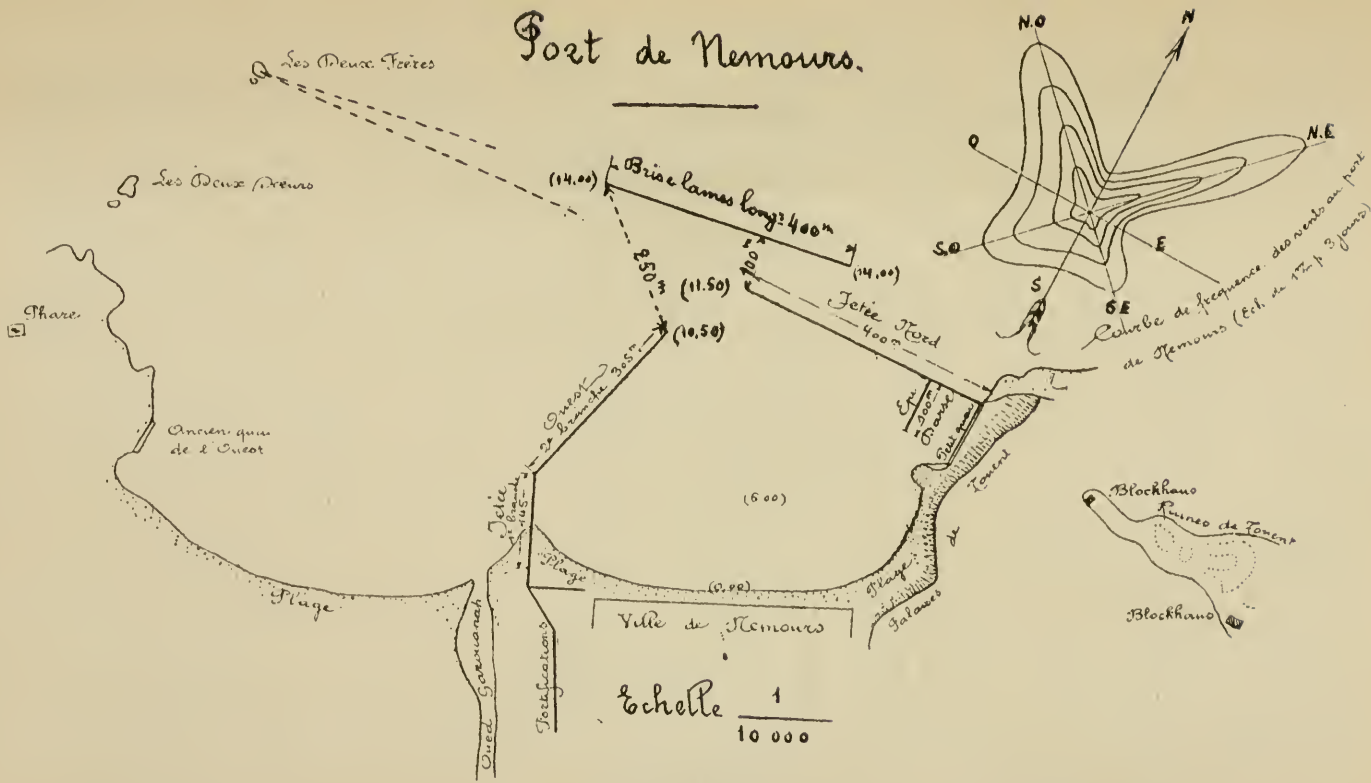
1° *Jetties.* Length of the North Jetty, 400 m. (437 yds.). Length of the West Jetty (first section), 145 m. (157.90 yds.) starting perpendicularly to the coast. Second section: 305 m. (333.47 yds.) (pointing towards the North). The channel is 125 m. (136.7 yds.) wide.

2° *Breakwater.* Length: 400 m. (437 yds.) pointing like the North Jetty in the direction of the rock known as « The Two Brothers ».

The area of the dock is 16 hectares (39.5 acres).

In the wet-dock, situated in the North-East angle of the port, a small quay has been constructed 30 m. (32.8 yds.) long with 1 m. 50 (4.9 ft.) depth of water along side, for loading and unloading goods in bad weather.

The wet dock has a depth of 4 to 5 m. (13.12 to 16.4 ft.), the dock has a depth varying from 0 m. at the beach to 11 m. 50 (37.5 ft.) in the channel.



. Port of Nemours.

Jetée Ouest = West jetty. — Ville de Nemours = Town of Nemours. — Jetée Nord = North jetty. — Phare = Lighthouse. — Les Deux Sœurs = The Two Sisters. — Les Deux Frères = The Two Brothers. — Courbe de fréquence des vents au port de Nemours = Wind chart for the port of Nemours.

The estimated cost of the works of the first stage (construction of North and West jetties) is about 3 million francs (works under way).

A sum of 12 to 15 million francs must be counted on for the works of the second stage, which remain to be done.

The cost is borne by the budget of the Colony. The township of Nemours will however share in the expense to the amount of 800,000 francs by means of a loan guaranteed by the maximum toll dues cited below, on all French or foreign ships putting into or remaining in the harbour of Nemours and which take on board or land passengers or goods.

1° per metric ton of goods embarked, landed, or transhipped	fr. 0.50
2° per ton registered tonnage	1.00

It was estimated that the traffic, which could be reckoned on, would be about 27,000 tons for goods landed or shipped, and 250,000 tons of registered tonnage.

These figures will certainly be exceeded when Nemours is linked up by railway to Marnia and especially to Oudjda.

(From information supplied, in November, 1920, by Mr. Borde, *Ingénieur des Ponts et Chaussées, at Oran.)*

PORT OF ORAN

Extension works of the port towards the East, begun in 1907 and finished in 1914 included:

1° *The construction of a dock of 18 hectares (44 acres) with quays* laid at (— 7 m. 40) and (— 8 m. 40) (24.3 ft. and 27.6 ft.).

2° *The establishment of an outer harbour of 60 hectares* (148 acres).

The total cost of the works estimated at 17,000,000 francs, rose to fr. 18,200,000.

The cost was borne:

1° by the French State (Naval Ministry) to the sum of 4,500,000 francs;

2° by the Chamber of Commerce of Oran to 8,200,000 francs;

3° The remainder by the Colony.

The French State and the Chamber of Commerce paid their subventions into the treasury of the Colony.

The receipts reckoned on based only on the revenue from tolls were 450,000 francs per year; the eventual increase in traffic was not taken into account in these evaluations, and the estimates were even based on the amount of traffic for the last six years.

The traffic has increased from 1,000,000 tons in 1906 to 1,800,000 in 1913, the receipts rose from 480,000 to 850,000 francs for the same period.

The works were carried out under the superintendence of the Chief Engineer of Roads and Bridges of the West Division, at Oran.

Other extension works of the port of Oran towards the East,

Port of Oran

Preliminary scheme of extension towards the east. — Definite arrangement of the platforms. — General plan.

Légende = Details. — Travaux terminés en 1913 = Works completed in 1913. — Travaux projetés, programme immédiat = Works proposed for immediate execution. — Travaux du nouvel agrandissement vers l'Est = Works for the new extension towards the east. — Agrandissement = Extension. — Quai de la gare = Station quay. — Nouveau bassin = New dock. — Vieux port = Old harbour. = Avant-port = Outer harbour. — Usine à gaz = Gas works.

the execution of which was decided on in 1913 (1), have for object:

1° *The construction of a new dock* of 15 ha. 6 (37 acres) with a minimum depth of 10 m. 40 and quays laid at the level (— 10 m. 40) (34.1 ft.).

2° *The construction of a new outer harbour* of 48 ha. (120 acres) with an average depth of over 12 m. (36.3 ft.).

The extension works properly called, shown on the annexed plan, are estimated at 70,000,000 francs.

The works for immediate construction were valued at 7 million francs.

The expense will be borne by the Chamber of Commerce to the amount of 34 million, and the remainder by the Colony. In order to cover itself for the expense entailed by these works and other necessary works, amounting to 6,600,000 francs, the Chamber of Commerce will be authorised to contract a loan of 40,600,000 francs guaranteed by tolls imposed on travellers and goods on entering the port, and by the revenue from the letting of the platforms of the port which will be conceded to this Association for a period of 75 years.

The amount of these subventions will be realized and paid into the Treasury in proportion to the progress of the work.

The total amount of the tolls and revenue from letting platforms of the port to be conceded to the Chamber of Commerce is estimated altogether at the minimum figure of 2,000,000 francs per year.

It is reckoned that the traffic which was 1,800,000 tons per year before the war, will reach 4,000,000 tons in 15 years, but the estimates of receipts were made in taking for basis the actual traffic figures during the years 1910-1914 without taking into account the increase in traffic mentioned above.

(From information supplied, in October, 1920, by Mr. Borde, *Ingénieur des Ponts et Chaussées, route du Port à la place d'Armes, Oran.)*

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(1) A publication issued by the Chamber of Commerce in 1913 gives the general lines of the scheme and justifies the economy of it.

Port d'Oran

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Plan Géné

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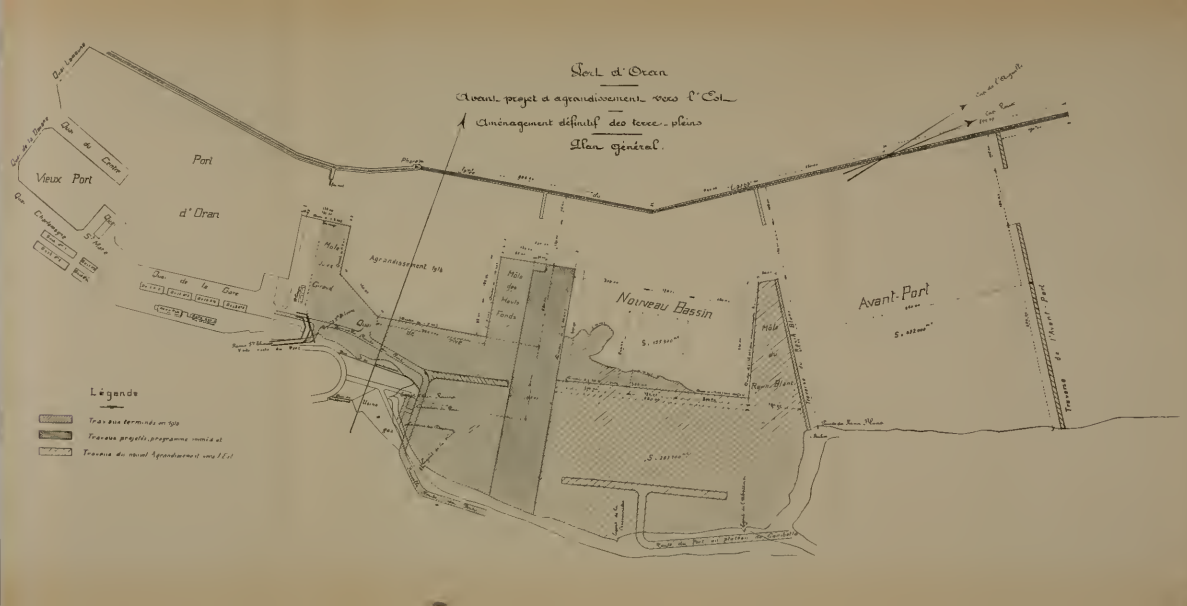
Traverse de l'Avant-Port

Egout de la Cressonnière


Port d'Oran
Avant projet d'agrandissement vers l'Est
Aménagement définitif des terre-pleins
Plan général
Vieux Port
Port d'Oran
Agrandissement 1914
Nouveau Bassin
Avant-Port
Légende
Travaux terminés en 1910
Travaux projetés, programme immédiat
Travaux du projet Agrandissement vers l'Est

PORT OF TENES

A preliminary scheme drawn up in 1912 for the interior arrangement of the port declared to be of public utility by a decree of July 8th, 1914, included:

The construction of a platform adjoining the Western curved jetty with quay-wall, railway lines, road and drains;

The dredging of the port to depths decreasing from 7 m. 50 (24.5 ft.) to 4 m. 50 (14.7 ft.).

The equipment.

The definite scheme of the carrying out of the works of the quay-wall, platforms and dredging was submitted for approval, in July, 1919.

The works proposed (see figure) are intended to put the port in a position to cope with the traffic brought by the railway as soon as the working of the line Ténès-Orléansville begins, this line is at present under construction.

The quay-wall follows the cord of the arc joining the commencement of the West jetty to the point South of the islet.

The depth on leaving the beach is:

0 m. to 3 m. (3.28 yds.) for a length of 90 m. (98.4 yds.);

4 m. 50 (14.7 ft.) for a length of 65 m. (71.67 yds.);

6 m. (19.7 ft.) for a length of 80 m. (87.44 yds.);

7 m. 50 (24.5 ft.) for a length of 200 m. (219 yds.);

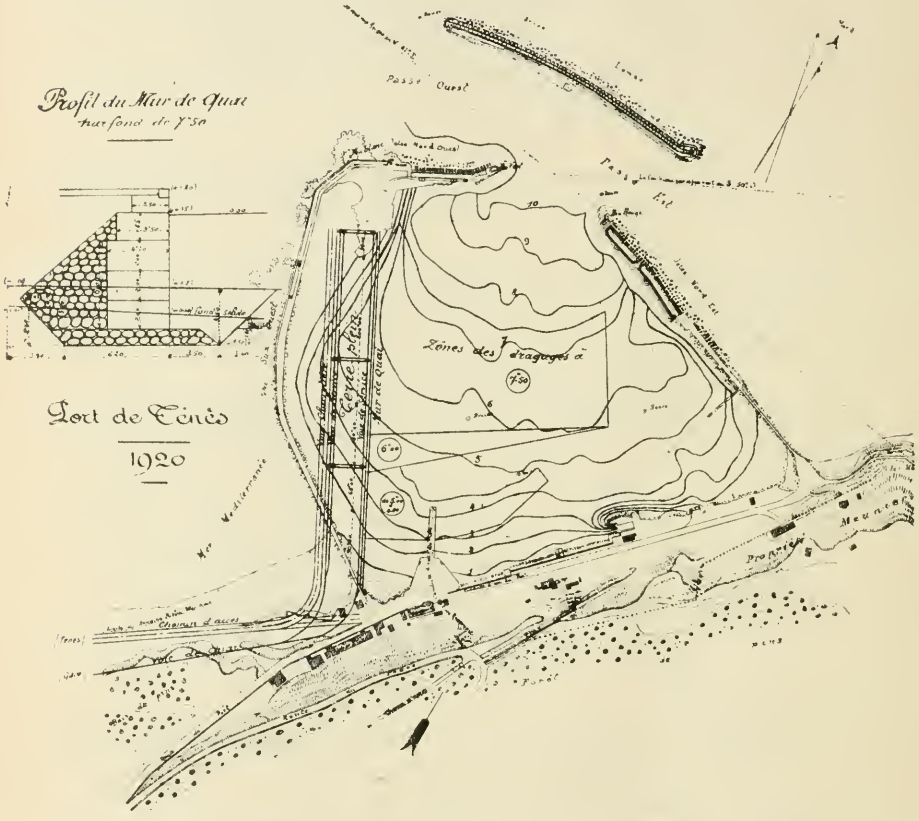
7 m. 50 to 3 m. for a length of 35 m. (38.27 yds.); to the junction of the island.

The platform in the rear of the wall includes a paved track 15 m. (16.4 yds.) wide, a storage area room of 1 1/2 hectares (3.7 acres), a road of 15 m. (16.4 yds.).

The wall, constituted to the level (+0 m. 35) of concrete poured into a wooden casing for depths of less than 5 m. (16.4 ft.) and, for greater depths, of layers of artificial blocks resting on a base of stone, will be crowned by a coping 1 m. 45 (4.6 ft.) high cemented in position and levelled to (+1 m. 80) (5.9 ft.). The railway line connecting the port with the station of Ténès will branch off in three lines on the platform, one will run along the quay, the two others on the road, linked up together by three cross-connecting lins provided with turntables.

On account of the present instability of prices of materials and of labour, it is impossible to give a definite estimate of the costs.

According to the preliminary scheme of 1912, the cost of the works amounted to .....fr. 1,150,000



Profil du mur du quai = Section of quay-wall. — Passe ouest = West channel. — Zones des dragages = Dredging zones. — Terre-pleins = Platforms. — Chemin d'accès = Road.

According to an evaluation made out taking present prices as a basis, an expenditure of .....fr. 3,000,000 must be reckoned on.

This cost will be borne by the Colony, except a subsidy of 200,000 francs which will be provided by the township of Ténès.

The district of Ténès was authorised by decree of November, 1914:

1° To contract a loan of 200,000 francs in order to meet expenses incurred by the realization of this scheme;

2° To collect tolls to pay off this loan.

It is considered that the traffic which averaged 17,690 tons for the years from 1910-1913 and which owing to the war decreased from 1914 to reach 7,121 tons in 1919, will attain 75,000 tons at the opening of the line Ténès-Orleansville, and 100,000 tons two or three years later.

(From information supplied, in June 1920, by Mr. Butavand, *Ingénieur en chef des Ponts et Chaussées, at Algiers.)*

CORSICA

OCEAN NAVIGATION

SEA PORTS

PORT OF AJACCIO

The works under way or definitely decided on in 1914 were as follows:

1° *Extension of the Cita del Jetty* over a length of 80 m. (87.4 yds.) and completion of the quays along this jetty;

2° *Removal of rock to the right of the Napoleon quay.*

No new work was decided on during the period of hostilities nor since, that is to say from 1914 to 1920.

The extension of the jetty de la Citadelle over a length of 80 m. (87.4 yds.) was intended, by reducing the entrance channel of the Port of Ajaccio, to diminish if not to prevent the propagation, in the port, of the swell from the South and, partly, that from the South-East.

The cost of the works of the preliminary scheme for the lengthening of the jetty was estimated in 1914 at 1,100,000 francs; the present cost would be 1,100,000×5 5,500,000 francs.

The State will bear one-third of the cost and the Chamber of Commerce of Ajaccio two-thirds.

The carrying-out of the works would not alter either the amount of receipts or the traffic.

Translation of French terms :

Port of Ajaccio.

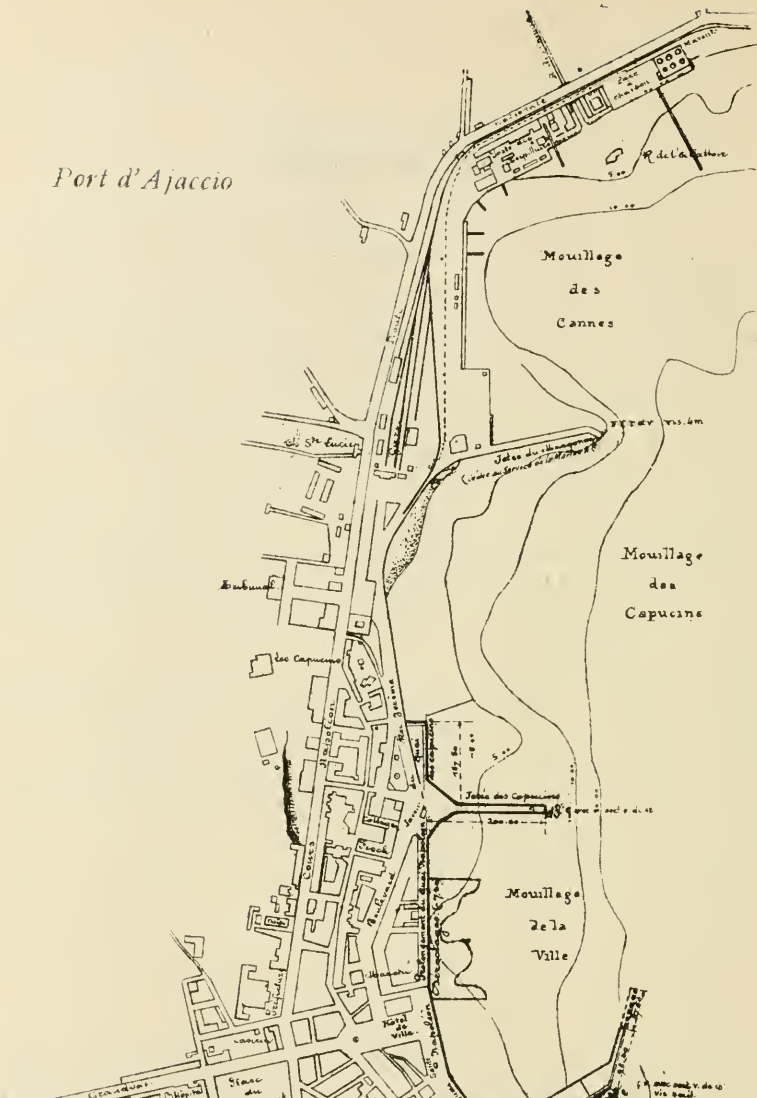
Mouillage des Cannes = Roadstead of Cannes. — Mouillage des Capucines = Roadstead of Capucines. — Parc de charbon = Coal park. — Poste des torpilleurs = Torpedo post. — Gare = Station. — Citadelle = Fortress. — Prolongement du quai Napoléon = Extension of the Napoleon Quay. — Jetée = Jetty.

Details.

----- Proposed works, not yet declared of public utility.

——— Works finished and at the disposal of the public.

-·-·- Works under way. Decree of 17th. Jan. 1913. Derocking to the right of the Napoleon quay.



Légende

---- Ouvrages projetés mais non encore déclarés d'utilité publique
—— Ouvrages terminés et livrés au public.
—.—.. Ouvrages en cours d'exécution - Décret du 17 janvier 1913
Dérochage au droit du quai Napoléon

The works for the removal of rock are intended to deepen the port of Ajaccio to the level (— 7 m.) (23 ft.) to the right of the new Napoleon quay. Dredging must complete the removal of rock. The excavations to be done, divided in three catagories, include the respective cubes of 3,360 cub. m., 12,610 cub. m. and 1,300 cub. m., estimated at 372,316 francs, guarantee of 37,684 francs not included.

The expenditure authorised was 410,000 francs, of which half is to be paid by the Chamber of Commerce of Ajaccio as a participation fund.

The works, stopped in September, 1914, could not be continued owing to the contractor not being able to acquire a dredger.

The receipts and traffic will not be influenced by the completion of these works.

(From information supplied, in October, 1920, by Mr. Reulos, *Ingénieur en chef des Ponts et Chaussées, Ajaccio.).*

Bibliography : Works connected with Ocean and Inland Navigation 1913, p. 203.

PORT OF BASTIA

1° Works decided on before 1914:

Construction of the St. Erasmus groin on a length of 50 m. (54.7 yds.) and the extension over a length of 250 m. (272 yds.) of the quay of the St. Nicolas jetty.

The construction of the St. Erasmus groin is to limit the channel from the land-side, to the depth of 6 m. (19.7 ft.) and to prevent the spreading in the port of the swell from the South, the only swell which penetrates in the present condition of the outer jetty.

The extension by 250 m. (272 yds.) of the St. Nicolas jetty is destined:

1° To increase the length of the quay for ships having a draft of 7 m. 50 (24.5 ft.) and also the area of the platforms of the port.

2° To lessen the risks of accident for vessels which, when leaving or entering the port, when the « Libeccio », a violent land-wind is blowing, might be blown towards the jetty, a thing which has already happened.

This work and that of the St. Erasmus groin were put up for tender, without result.

The cost of the construction works of the St-Erasmus groin and the extension on a length of 250 m. (272 yds.) of the quay of the St Nicolas jetty, comes to a total sum of 910,000 francs.

The cost is borne in equal shares by the State and the Chamber of Commerce of Bastia.

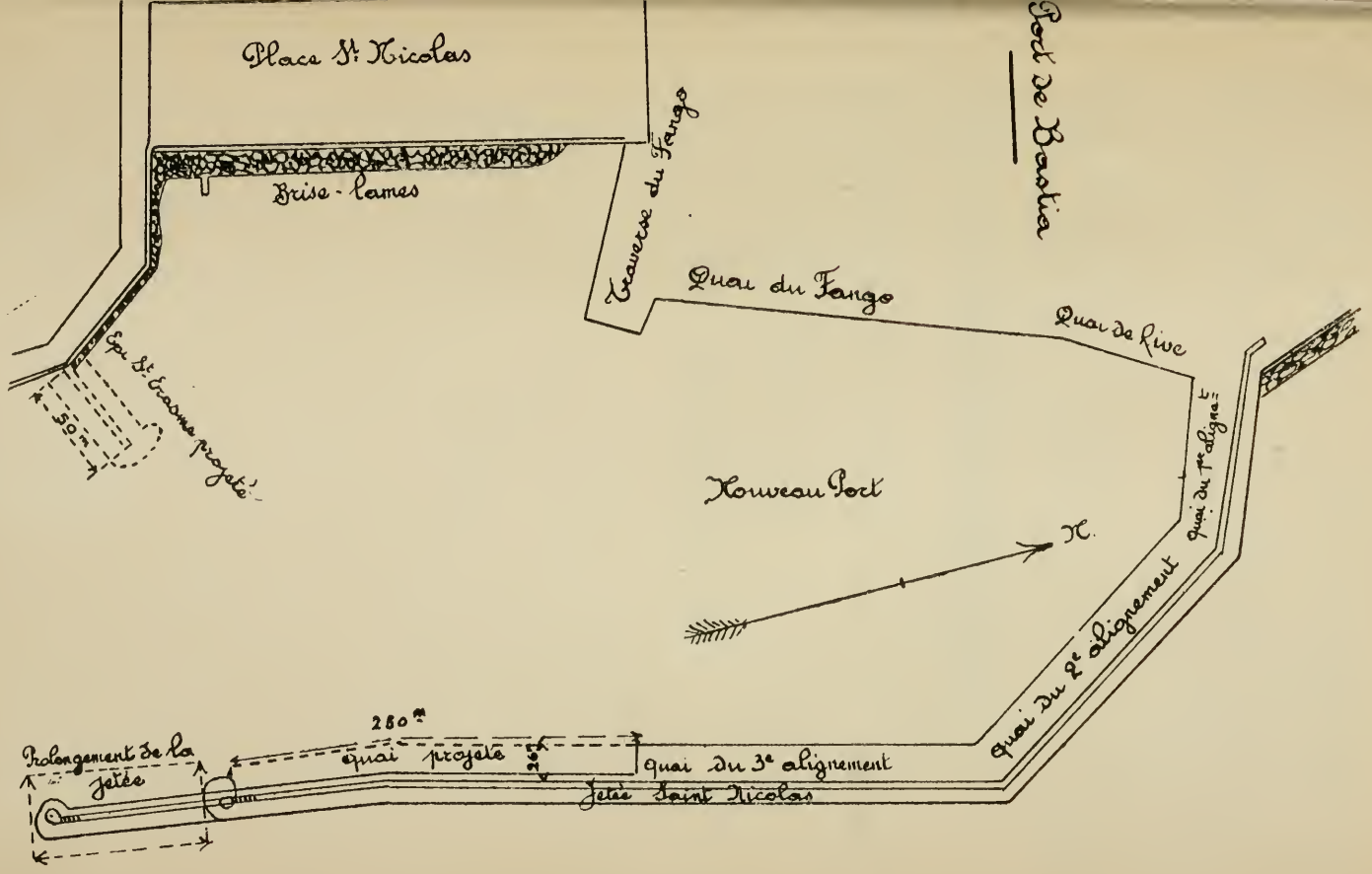
No new work was decided on during the years 1915 to 1919 inclusive.

* * *

2° Works completed in 1914:

Construction of a quay 200 m. (218 yds) long along the St. Nicolas jetty.

This quay is accessible to packet-boats drawing 7 m. 50 (24.5 ft.).



Port of Bastia.

Brise-lames = Break-water. — Epi St. Erasme projeté = Proposed St. Erasmus groin. — Nouveau port = New port. — Prolongement de la jetée = Extension of the jetty. — Quai projeté = Proposed quay.

This quay facilitates the traffic of cumbersome goods (round timber, coal, cork).

The cost is included in the contract for the extension of the St. Nicolas jetty over a length of 90 m. (98.4 yds.) which work has been suspended since the war.

The cost was borne in equal shares by the State and the Chamber of Commerce of Bastia.

No increase of receipts is to be looked for from the works proposed or carried out, the object aimed at merely being to facilitate business and ensure the safety of navigation.

(From information supplied, in October, 1920, by Mr. Reulos, *Ingénieur en chef des Ponts et Chaussées, at Ajaccio.)*

Bibliography : Works connected with Ocean and Inland Navigation, 1913, p. 206.

MADAGASCAR

OCEAN AND INLAND NAVIGATION

MADAGASCAR

The Colony of Madagascar decided several years ago to construct:

1° *A deep water harbour at Tamatave;*

2° *A canal for inland navigation along the East coast from Foulpointe to Farafangana.*

It seeks also to improve its system of natural navigable waterways.

The port of Tamatave is to serve as terminus for the railway from Tananarive to the East coast. It will be the port of transit for products for the high plains, or going to the capital and neighbourhood.

The scheme for the port of Tamatave was drawn up in 1911 by the Chief Engineer, Mr. Bourgougnon, and adopted with various amendments by the Comittee of Public Works and Colonies.

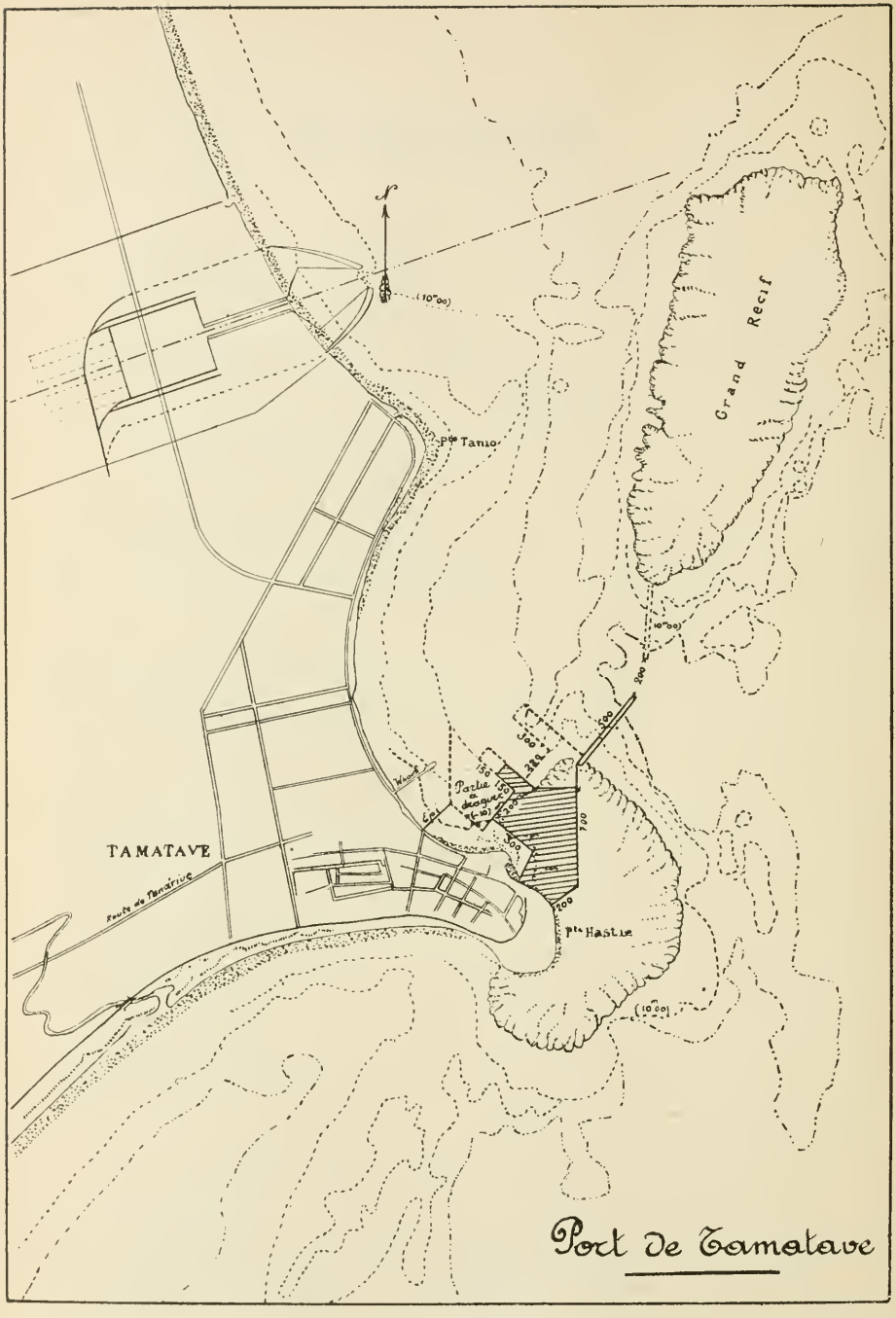
It consists of the construction of a dock between the Hastie reef and the town. The general situation of the roadstead is improved by commencing an outer jetty at the North-East side of the Hastie reef running towards the North 40° East. The jetty is connected with the shore at Point Hastie *by a wall built on the flat top of the reef.* The port, properly speaking, is placed behind a traverse bedded in the North-East face of the Hastie reef. This traverse is lined on one side by an *outer protecting wall,* on *the other by a quay-wall. Another quay* is constructed on the North-West side of the reef following a direction perpendicular to the traverse.

The works are estimated at 22 million francs.

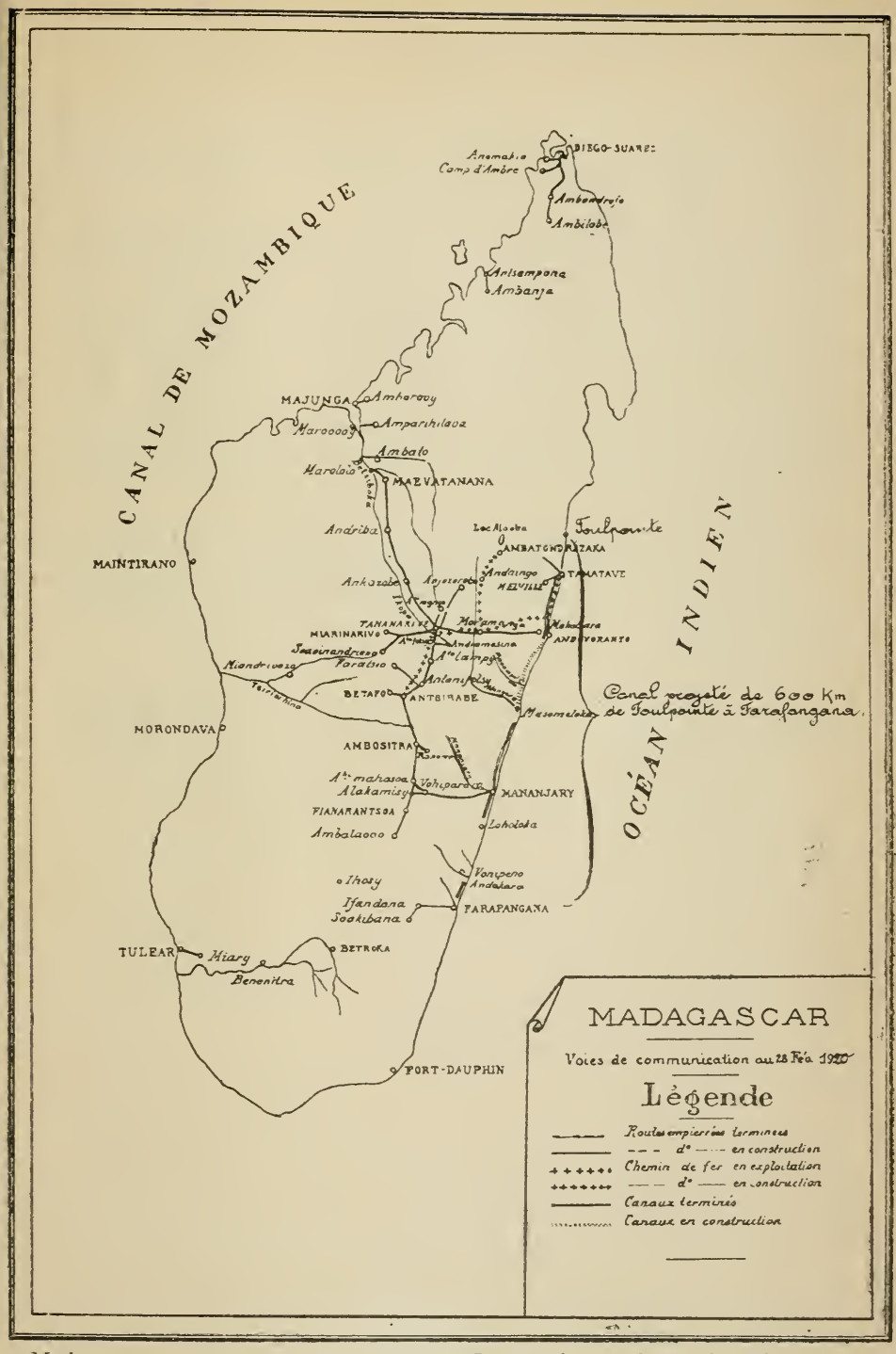
The cost will be borne by the Colony of Madagascar.

The receipts have not been estimated, as the Colony does not look upon this port as a source of revenue by creating taxes.

The present traffic of Tamatave is about 100,000 tons per year. It is not the construction of a port which will increase, but indeed the construction of new railways now being laid down



Port of Tamatave.
Grand récif = Great reef. — Partie à draguer = Part to be dredged.



Madagascar. — Canal projeté de 600 km. = Proposed 375 mile canal.— Voies de communication = Lines of communication. — Legende = Details. — Routes empierrées terminées = Roads finished. — Routes empierrées en construction = Roads under construction. — Chemin de fer en exploitation = Railway being worked. — Chemin de fer en construction = Railway under construction. — Canaux terminés = Canals completed. — Canaux en construction = Canals under construction.

towards Maotra and Antserabe, which will bring there an important freight. It may be hoped that the port will handle, in the near future, 200,000 tons per year.

The canal of the Pangalanes is intended to link up between them the lagoons and estuaries which exist over more than 600 kilometres (375 miles) along the East coast. This coast being dangerous for small ships engaged in the coasting-trade, is hardly used by sailing-vessels which could load produce brought by water at all the river estuaries. The canal des Pangalanes will make up for this lack of communication by sea. Its characteristics will be: width at bottom 15 m. (16.40 yds.); depth 1 m. (3.28 ft.).

The works are estimated at 20 million francs.

The expenditure will be borne by the Colony of Madagascar.

No tax will be levied on this canal, which will be an absolutely free waterway.

It is difficult to estimate the traffic that may accrue.

(From information supplied, in June, 1920, by the Director of Works for the Colony of Madagascar.)

SENEGAL

OCEAN NAVIGATION

SENEGAL

Works under consideration for fixing the mouth and arranging the bar of the river Senegal.

The entrance of the river Senegal and of the port of St. Louis presents difficulties which can be summed up as follows:

1° Rough sea in the channel making it impossible to enter the port during 100 days of the year;

2° Constant changes in the channel, which necessitate a daily buoying. The windings of the river sometimes so pronounced as to prevent the entire depth of the channel being utilised;

3° Insufficient depth, the depth marked of the exterior shallows varying between 2.50 and 4 m. (8.2 and 13.1 ft.).

These difficulties constitue serious obstacles, firstly for navigation, and secondly for the development of one of the most interesting districts of Senegal.

They are also a source of considerable expense for trade.

The works under consideration are intended to do away with all these obstacles.

The scheme (see plan annexed) consists of opening in the « Langue de Barbarie » a new channel excavated to 6 m. 25

Translation of French terms :

Map of the neighbourhood of St Louis.

Echelle = Scale. — *a)* Digue submersible = *a)* Submersible dike. — *b)* Digue sud en mer = *b)* South dike out to sea. — *c)* Digue nord en mer = *c)* North dike out to sea. — *d)* Levée interieure de R. D. = *d)* Inner embankment of R. B. — *e)* Zone à draguer = *e)* Zone to be dredged. — *f)* Zone de la Langue de Barbarie à consolider = *f)* Zone of the Langue de Barbarie to be consolidated. — Les millésimes indiquant les positions de l'embouchure du fleuve Senegal à différentes époques = The years indicate the position of the mouth of the river Senegal at different periods. — Ile de Thiona = Thiona Island. — Terrain inondé = Flooded land. — Terrain inondé pendant l'hivernage = Land flooded during winter. — Anse = Creek.

(20.4 ft.) below the level of low water mark and allowing the entrance, under any circumstances, of vessels with a maximum draft of 6 m. (19.7 ft.).

The new channel will be surrounded by a submersible curved dike forming the left bank, and by two dikes seaward distant 750 m. from each other, one to the North, would be lengthened by an inner embankment joining its commencement to the natural bank of the river.

The whole part of the « Langue de Barbarie » situated to the North of the new mouth will be consolidated by special wicker work and plantations.

The dike of the left bank is to cross the river following a curve of 2,500 m. (2,500 yds.) radius. It will be cut down in the submersible portion to the level 0 m. 60 (1.96 ft.).

Its cross-section is established in giving to the slope the natural slope of rocks, its total length will be about 2,400 m. (2,630 yds.).

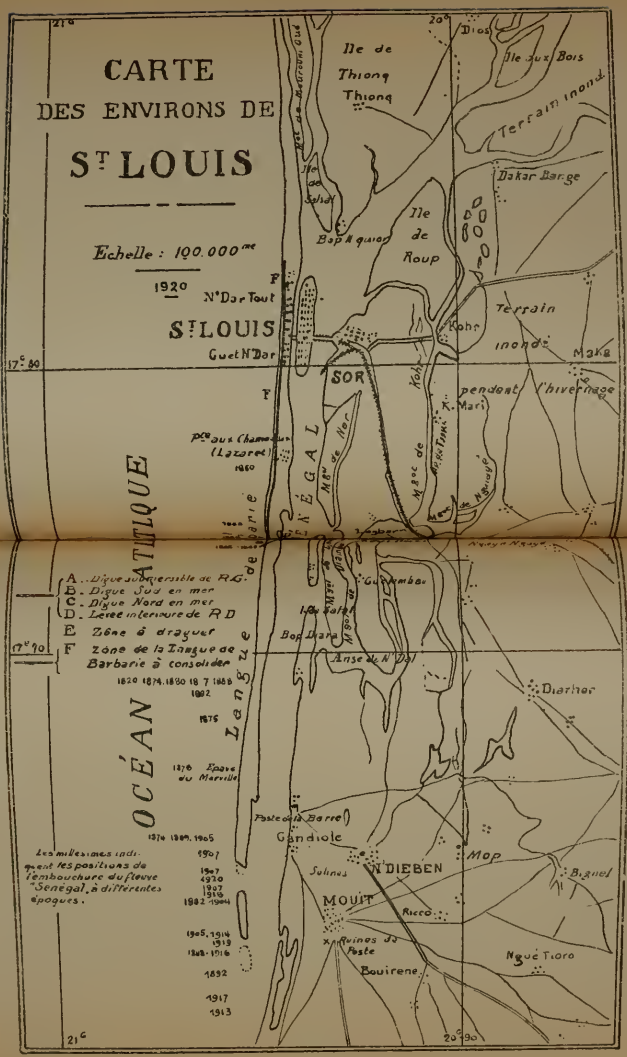
The North-dike (R. B.) will stretch out seaward to the level of 9 m. (29.5 ft.) at low water. Its object is to stop the sand coming from the North which tends to encumber the channel. It is traced following a straight line running towards the S.-S.W. Its cross-section will be formed by rough stone of 2 and 3 categories. It will be 7 m. (7.65 yds.) wide at the level 2 m. 50 (8.2 ft.) which is that of the tidal bore. Its total length will be about 942 m. (1,029 yds.).

The inner portion will be a rough stone dike of circular shape, levelled to 3 m. (9.84 ft.) and 2 m. (2.2 yds.) wide at the top. Its total length will be about 1,200 m. (1,305 yds.).

The South dike (L. B.) prolongs seaward the dike of the left bank. Its trace is rectilineal and advances to the 3 m. (9.84 ft.) depth. Its cross-section will be that of the left bank dike. It will be cut down to 0 m. 60 (1.96 ft.) and its total length will be about 150 m. (164 yds.).

The detailed estimates amount to about 36 million francs. This estimate will no doubt be exceeded owing to alterations in the size and disposition of the works while working out the plan of the scheme.

The research work necessary for the realization of the scheme


CARTE
DES ENVIRONS DE
ST LOUIS
Echelle : 100.000me
1920
ST LOUIS
N'Dar Tout
Guet N'Dar
SOR
Pte aux Chameaux
(Lazaret)
1860
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Ile aux Bois
Terrain inond.
Dakar Barge
Ile de Roup
Terrain inond.
Maka
pendant l'hivernage
Kohr
Bop Diarre
Anse de N'Dar
Diarthor
Gandiole
N'DIEBEN
Mop
Biguel
MOUIT
Ruero
Ruines du Poste
Bouirene
Ngue Tioro
OCÉAN ATLIQUE
Langue de Barbarie
A. Digue submersible de R.G.
B. Digue Sud en mer
C. Digue Nord en mer
D. Levee interieure de R.D
E. Zone à draguer
F. Zone de la Langue de Barbarie à consolider
1820 1874 1830 18 7 1888
1882
1875
1876 Epave du Marsouin
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1907
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1905, 1914
1913
1848-1916
1852
1917
1913
Les millesimes indiquent les positions de l'embouchure du fleuve Senegal, à differentes époques.
17° 30
21°
20°
20° 30

has been the subject of some notes in the « Official Report of the Committee of historical and scientific studies of French East Africa » 1918 and 1919.

(From information supplied by M. Pierre Lamse, *Director of Public Works, in charge of the improvement research works of the mouth of the Senegal river, at St. Louis.)*

PRINCIPALITY OF MONACO

OCEAN NAVIGATION

SEA PORTS

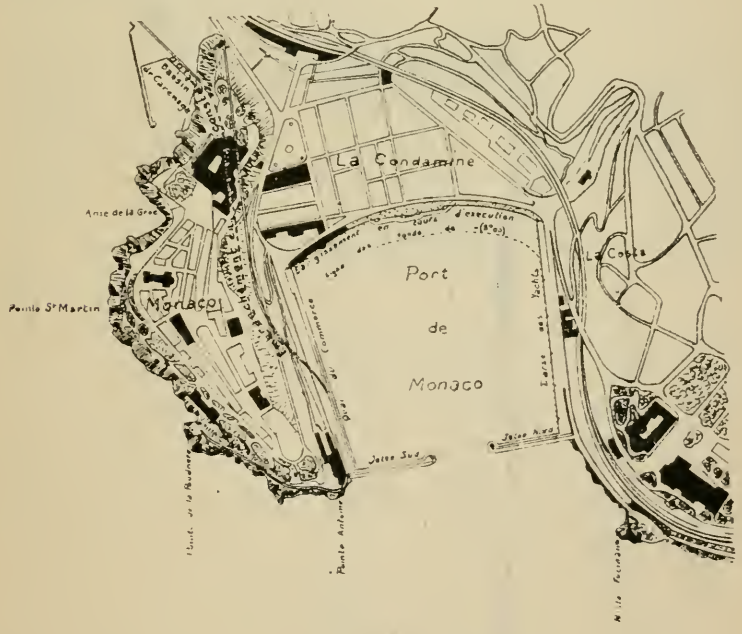
PRINCIPALITY OF MONACO

PORT OF MONACO

1° *Widening of the Boulevard de la Condamine* by a reinforced concrete platform, constructed so as to overlap on the beach and supported by piles also of reinforced concrete.

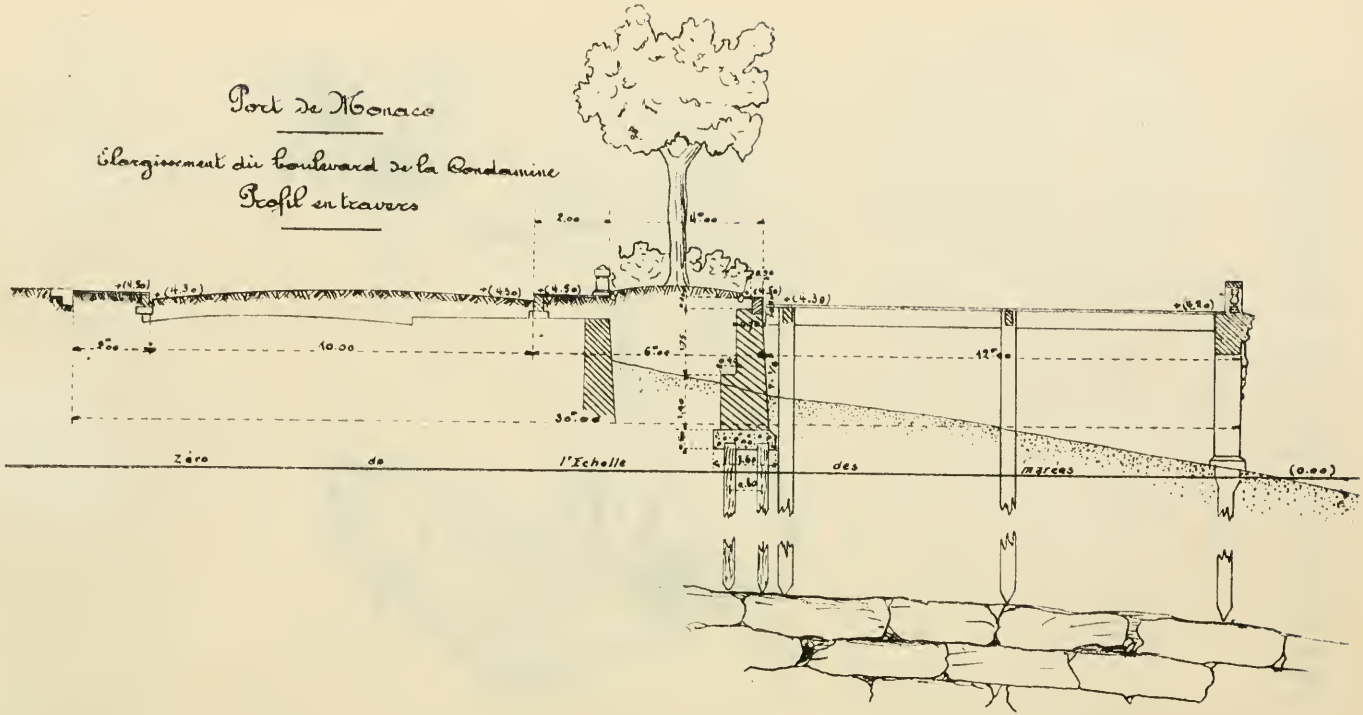
The widening is carried out, on a length of about 440 yds., by moving forward the retaining wall of the old boulevard so as to give the roadway a uniform width of 10 m. (10.93 yds.) between a pavement of 2 m. (2.187 yds.) running along the buildings and the following works situated on the sea-side:

a) A flower bed 4 m. (4.37 yds.) in width between the old and new retaining walls;



Port of Monaco.

Elargissement en cours d'exécution = Widening being carried out. — Jetée sud = South jetty. — Jetée nord = North jetty. — Bassin de carénage = Careening dock. — Darse des yachts = Wet dock for yachts. — Anse de la Gree = Bay de la Gree. — Embranchement en construction = Branch line under construction. — Bassin = Dock.



Port of Monaco.
Widening of the Boulevard de la Condamine.
Profil en travers = Cross-section. — Echelle = Scale. — Marées = Tides.

b) A reinforced concrete platform 12 m. (13.12 yds.) wide, forming a promenade and resting on concrete piles driven in the sand.

In the middle of the bay the boulevard is widened in the form of a rotunda over a length of 100 m. (109.36 yds.), with a width of 30 m. (37.8 yds.), the whole at the level (4 m.) (13.2 ft.) the rotunda itself is bordered by a quay 6 m. (6.56 yds.) wide at the level (1 m. 80) (5.9 ft.) for fishing and pleasure boats. The works are under construction.

The extension works of the Boulevard are estimated at 2 million francs. Their principal object is to beautify the Principality.

2° Piercing of a second tunnel under the rock of Monaco in view *of laying a railway line connecting the branch line of the port with the Fontvielle platform.*

The junction tunnel is 410 m. (448 yds.) long on the level. It starts in the existing tunnel at a distance of 70 m. (76.5 yds.) from its Eastern end and opens on to the platform at the level 5 m. 10 (16.7 ft.). The works are under construction.

They are estimated at 700,000 francs for the earthworks alone.

The Fontvieille line is intended to serve the factories which will be established on the platform and to permit the quay being cleared in case of intensive unloading of goods.

The cost of the whole of the works will be borne by the Government of the Principality.

> *(From information supplied, in May, 1920, by* Mr. R. CHAUVET, *Ingénieur des Ponts et Chaussées, in charge of the works of the Port of Monaco, at Monaco.)*

Bibliography : Works connected with Ocean and Inland Navigation, 1913, p. 217.

INDEX

FRANCE

I. INLAND NAVIGATION

a) Free running and canalized rivers

PAGES

Loire river 5

Works for improving the navigability of the Loire between Montjean and Nantes.

Marne river. 6

Construction of a port at Bonneuil and works for the improvement of the Marne, between its confluent at Charenton and the port of Bonneuil. Construction of graving slips at Charenton; lengthening and widening the Créteil lock.

Rhône river 10

Improvement and extension of the port of Valence on the Rhône.

Seine river 11

Lengthening the Port haut de Javel, at Paris, between the Grenelle and Mirabeau bridges, left bank.

Seine river 13

Construction of a port at Ivry on a length of 1,250 m. (1,367 yds.), between the Conflans bridge and the limits of the Paris octroi.

Seine river 16

Water-side station at Montereau connected with the P.-L.-M. Railway.

Navigable routes damaged through the war : Repairs (see *Canals*).

Scheldt canalized (see *Canals* : The lateral canal to the river Oise, Saint-Quentin canal and the canalized Scheldt). 21

b) Canals

Lateral canal to the river Oise, Saint-Quentin canal and the canalized Scheldt 21

Installation of electric towing by tractors.

Canal from the Marne to the Saône 29

Connection of the canal at Heuilley-sur-Saône with the Gray-Auxonne railway-line and plant for transhipment from wagons to barges. Connecting line from the transhipment port of Fort-Carré to Saint-Dizier with the Est Company's station of the same locality. Quay-wall along the port of Fort-Carré.

Pages

Canal from the Marne to the Rhine 25

Installation of electric cable towing in and near the Foug tunnel. Repair of the masonry work of the Mauvages tunnel.

Midi canal and lateral canal to the Garonne 31

Deviation of the Gargailhan stream at the crossing of the Midi canal near Béziers ; weir at Beauregard on the Garonne near Agen ; junction of the waterway, on the right bank of the port of Saint-Sauveur, at Toulouse, to the Midi railway line.

Canal from Montbéliard to the Haute-Saône 34

Works carried out ; works under construction.

Nord canal 44

Repair works ; completion works.

Canal from the Rhône to the Rhine 47

General improvement of the canal : 1° between Besançon and Montreux-Château ; 2° between Besançon and the Saône.

Canal from Roanne to Digoin 49

Building of a new dock (Oudan port).

Navigable waterways damaged through the war : Repairs (Est canal, north branch ; Ardennes canal ; the canal from the Aisne to the Marne) 52

c) **Ports**

Port of Nantes (see *Ocean navigation*) 61

Port of Rouen 57

Construction of wooden berth (see also *Ocean Navigation*, p. 147).

II. OCEAN NAVIGATION

a) **Tidal rivers**

The maritime Loire and the port of Nantes 61

Improvement works between Nantes and the sea ; improvement works of the port of Nantes. Wharves of the Usine Brûlée ; Paimbœuf wharf ; Donges wharf ; construction of a post for the discharging of petroleum at Donges ; quays on piles below the Pirmil arm.

PAGES

The maritime Rance 68

Fixing of the channel at the crossing of the Lessart Banks.

The maritime Seine (see *sea ports :* Port of Rouen) 147

b) **Ships canals**

Ship canal from Caen to the sea and its ports. 71

Extension of the quays of the new dock at Caen as far as the Calix bridge ; widening and deepening of the canal ; construction of a 200 m. (218 yds.) quay at the new dock of the port of Caen.

Cette ship canal. 76

Reconstruction works of the Montpellier, swing-bridge on the canal at Cette.

Canal from Marseilles to the Rhône 79

Completion of the southern port of the port of La Lave and completion of the dike protecting the maritime portion of the canal (part included between the port of Marseilles and the Rove tunnel).

c) **Sea ports**

Port of Bordeaux 83

Extension of the floating dock of Bordeaux ; construction of new wet docks. Reconstruction of the old vertical quays on the left bank ; widening of platforms. Transformation of the Lucien Faure slip ; transformation of the Richelieu slip. Wharf and grain unloader for the Grands Moulins de Bordeaux ; lay out of groups of sidings and shunting lines.

Port of Bordeaux-Bassens 90

Wharf fitted with plant for the rapid handling and storing of cereals ; the same for the rapid handling of coal and heavy matters. Unloading wharves. Bassens-amont wharves : Bassens-aval ditto.

The ports of Bordeaux and of the Gironde 95

The construction of an outer harbour in deep water at the Verdon ; wharves for large steamers for the port of Blaye.

Brest (Naval port) 98

Construction of two large graving docks at Laninon.

PAGES

Port of Calais 101
Construction of a terminus station for ferry-boats to the right of the wood dock of the Carnot Basin; completion of the work of deepening at the foot of the South-East quay of the « Ouest » floating dock.

Port of Dieppe 105
Construction of new entrance and quays for the fishing industry.

Port of Honfleur 108
Construction of a new quay with platforms at the Carnot dock.

Lorient (Naval harbour). 110
Construction of the new graving dock n° 3, of a reinforced concrete wharf, of a covered construction dock, of a landing-stage and sheds called « de la Roumanie », and of a slip for launching large hydroplanes.

Lorient (Fishing port) 117
Reasons which justify the construction of a fishing port; conditions which a large fishing port must fulfil; railway tracks of the port and junction with the station; equipment.

Port of Marseilles 139
Construction of the quay north of Cape Janet traverse.

Port of Nantes (see *Ocean navigation*: The Loire and the port of Nantes). 61

Port of Pauillac 141
Plant for unloading and handling mazut at the Pauillac-Trompeloup public wharf; installation for the rapid unloading of coal; extension of the maritime station of Pauillac-Trompeloup.

Port of Rochelle-Pallice 144
Excavation in the outer harbour, at the foot of the north jetty, of a channel and enlargement of the wharf channel; lengthening of the wet dock.

Port of Rouen 147
Improvement of approaches; construction of docks; construction of quays; of a graving dock; dredgings. Construction of reinforced concrete landing stages; construction of berths for ocean-going ships; works connected with the railway lines and equipment.

Port of Saint-Nazaire. 155
Construction of a reinforced concrete landing-stage; construction of a wooden landing stage.

ALGÉRIA

OCEAN NAVIGATION

Sea ports

Pages

Port of Algiers 159
Works for the completion of the inner port of Agha : widening works at the north of the Admiral Mouchez mole.

Port of Arzew 161
Extension works of the port.

Port of Bône 165
Construction of a quay 218 yds. long to the south of the large dock.

Port of Bougie 167
Construction of a jetty out to sea : the raising and lengthening of the quay Ribaucourt ; construction of the second part of the north-west quay ; construction of the Casbah mole and a connecting jetty ; dredging of the harbour and laying of railway tracks.

Port of Collo. 168
Construction of a new shelter jetty ; construction of two quay-walls ; construction of a slip for boats and small vessels ; arrangement of platforms.

Port of Djidjelli. 172
Construction of the jetty of Djidjelli.

Port of Mostaganem 174
Deepening of the port ; construction of quays ; platforms and slip. Lengthening of the large jetty and accessory works.

Port of Nemours 176
Construction of a harbour of refuge ; of two jetties ; of a breakwater ; of quay-walls and dredging work.

Port of Oran. 179
Extension works of the port. Construction of a dock of 11 acres with quays ; establishment of an outer harbour of 148 acres.

Port of Ténès 181
Interior arrangement of the port ; construction of a platform with quay-wall, railway lines, road and drains ; dredging and equipment.

CORSICA

OCEAN NAVIGATION

Sea ports

PAGES

Port of Ajaccio 187

Extension of the Citadel jetty and completion of the quay along this jetty ; removal of rock to the right of the New Port quay.

Port of Bastia 190

Construction of the Saint-Erasmus groin and extension of the quay of the Saint-Nicolas jetty.

MADAGASCAR

INLAND NAVIGATION

Construction of a canal for inland navigation along the east coast from Foulpointe to Farafangana 195

OCEAN NAVIGATION

Construction of a deep water harbour at Tamatave 195

SENEGAL

OCEAN NAVIGATION

Works under consideration for fixing the mouth and arranging the bar of the river Senegal 201

PRINCIPALITY OF MONACO

OCEAN NAVIGATION

Sea ports

Port of Monaco. 207

Widening of the boulevard de la Condamine by a reinforced concrete platform ; connecting the branch line of the port with the Fontvieille platform.

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